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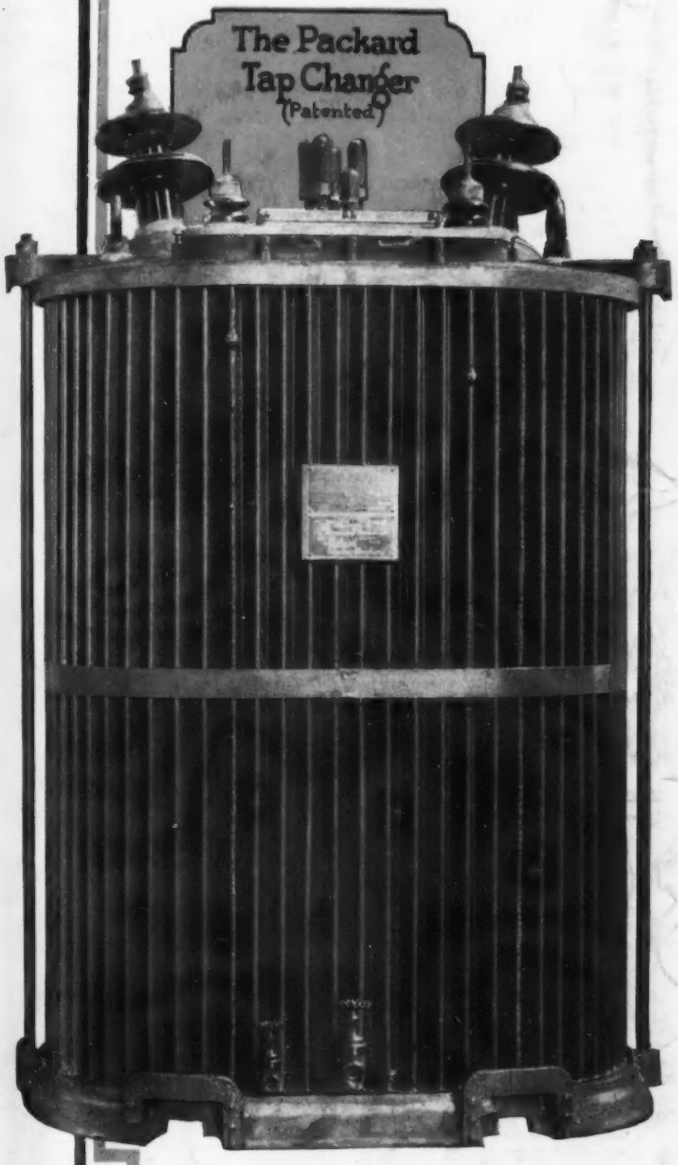
Founded March 1, 1874—Fifty Years of Service

Electrical World

McGraw-Hill Company, Inc. *October 4, 1924* Twenty-five Cents Per Copy

Many Transformer Developments in the Last 34 Years



Late Model Packard single phase unit showing Packard tap changer installed.

TIMES have changed since the first Packard transformer was designed in 1890—the electrical industry has changed — transformers have changed—

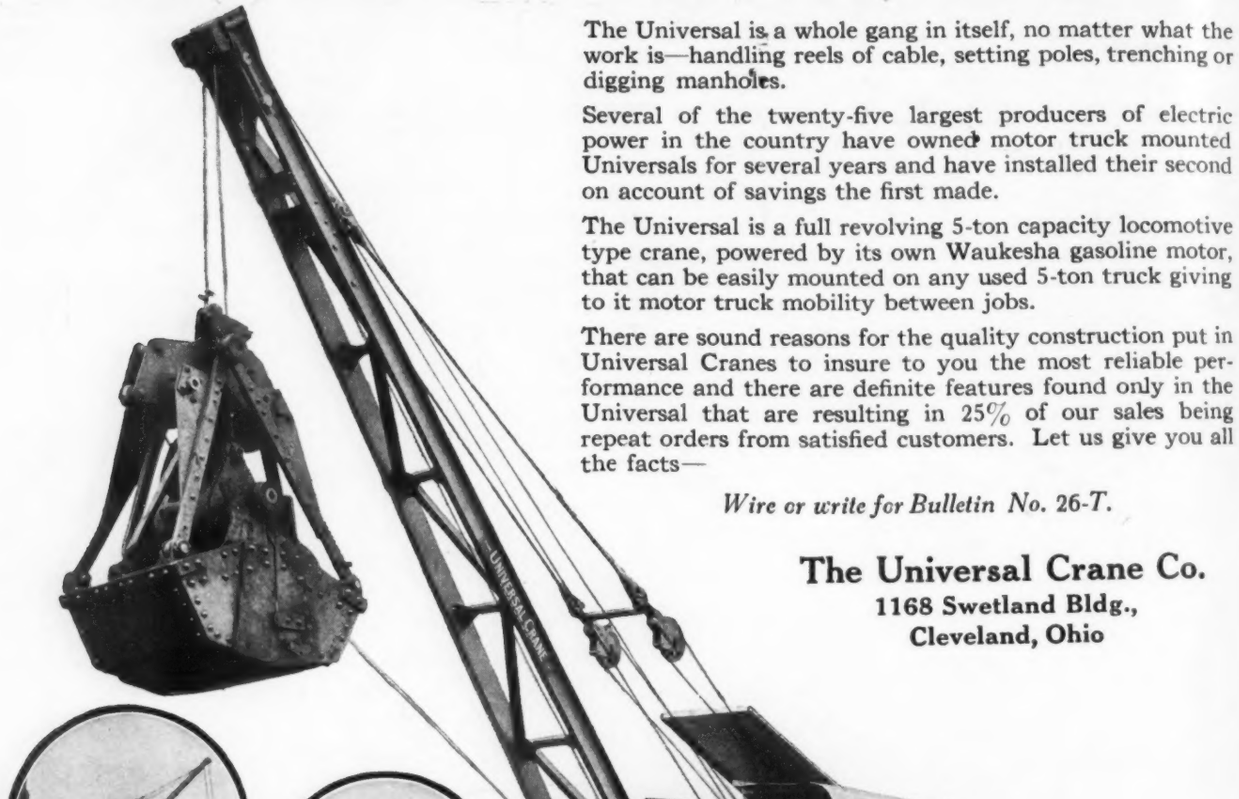
But Packard Quality has NOT changed—

that craft spirit which comes only from a compact, highly specialized organization.

For that reason the Packard Electric Company many years ago disposed of the Packard Automobile to the Packard Motor Car Company, and the Packard lamp to the General Electric Company—each of which products, like the Packard transformer, was built for the highest place in its field.

THE Packard ELECTRIC CO.
WARREN, OHIO

Equal to a Gang of 20 Men!



The Universal is a whole gang in itself, no matter what the work is—handling reels of cable, setting poles, trenching or digging manholes.

Several of the twenty-five largest producers of electric power in the country have owned motor truck mounted Universals for several years and have installed their second on account of savings the first made.

The Universal is a full revolving 5-ton capacity locomotive type crane, powered by its own Waukesha gasoline motor, that can be easily mounted on any used 5-ton truck giving to it motor truck mobility between jobs.

There are sound reasons for the quality construction put in Universal Cranes to insure to you the most reliable performance and there are definite features found only in the Universal that are resulting in 25% of our sales being repeat orders from satisfied customers. Let us give you all the facts—

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The Universal Crane Co.
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Universals can be easily transferred from motor truck to crawler mountings, flat cars, traction wheels, etc. The change from clam-shell bucket to hoist block is quickly made.

Electrical World

The consolidation of Electrical World, Electrical Engineer and American Electrician

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W. H. ONKEN, JR. Editor — HAROLD V. BOZELL Editor

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New Capital Flotations for Public Utilities

THE record of new capital flotations in this country for the eight months ended August 31 shows to what an extent public utilities, and particularly electric public utilities, have eclipsed the steam railroads of the country in financial operations. Compared with the same period last year, the steam railroads raised twice as much money this year—$634,762,437 in all, of which $156,000,000 was for refunding. The public utilities, on the other hand, raised in eight months more than $1,089,000,000, of which $130,000,000 was for refunding, compared with only $674,000,000 for the similar eight-month period of 1923.

A significant feature of the financial operations of public utilities during that time is that three times more money was raised this year by the sale of stock, whereas the bond issues show only a 20 per cent increase over last year and represent this year approximately 60 per cent of the total money raised. At the present rate it would appear that 1924 will show twice as much money raised by public utilities as by the steam railroads, and most of it, more than 85 per cent, is new capital, giving an excellent example of utility growth in a year of general industrial depression.

A Warning That Will Be Heeded

HERBERT HOOVER in an address broadcasted by radio last Monday evening may have voiced good Republican doctrine and possibly good Democratic doctrine also. At any rate, it was sound American doctrine, and, entirely aside from its political aspect, the speech should be read by every man engaged in the electric light and power business in this country. It gives a reason and a defense for our present system of public utility service under private ownership and public regulation and describes clearly and dispassionately the dangers of government ownership and operation. One might think that with all the evidence of failure attending government operation abroad and in this country such a warning would be unnecessary; but unfortunately such is not the case. The Pacific Coast States are at present tainted with doctrines of government ownership in various forms, and California and Washington will decide next November whether they will continue to rely on private initiative and enterprise in electric public utility service or turn to state and municipal ownership.

Throughout the whole land also forces to which the genesis of the American commonwealth is unknown are being marshaled in an attack on private ownership and on that citadel of American institutions, the Supreme Court. In this land, literally flowing with milk and honey, an attempt is being made, under the guise of a "progressive movement," to array socialists, discontented farmers and possibly labor against existing institutions and by means of federal usurpation to destroy the foundations of our national progress. That such a movement will succeed is unthinkable, but Mr. Hoover does well to train his guns on would-be destroyers of the fundamental laws and customs that have given to the United States its unique place in the world and have stood the test of so many generations.

This, Too, Shows the Need for More Light on Lighting

HAVING in mind the fact that virtually the entire electrical industry is at the moment engaged enthusiastically in supporting a great educational campaign to teach the school children of America to safeguard their eyesight by the proper use of electric light, there is a curious significance in a statement which appears in the current issue of the *World's Work*. In an article entitled "The American Home and the Younger Generation," William Lyon Phelps, Lampson professor of English literature at Yale, writes:

"The electric light, with its enormous convenience, is not so good for reading purposes as the old kerosene lamp—and there are still many Englishmen who read and write by candlelight."

Was there ever a better illustration of the urgent need for a practical interpretation of the way to use electric light—and the "why" of it? Though frankly admitting its convenience, Professor Phelps disposes of electric light with a wave of the hand, selecting for comparison in his mind's eye the ideal kerosene reading lamp (of doubtful memory) and the commonly ill-used electric lamp that has been thoughlessly selected as to size and type, carelessly equipped and placed with no regard to glare or gloom. The fact that a coal-oil lamp in ordinary service is dingy and clumsy and has a badly trimmed wick is entirely lost sight of, as is the fact that from the standpoint of eye conservation electric lamps are commonly misused. All of which is stressed here not in defence of the electric light against kerosene, for that needs no argument, but rather in support of the purpose behind the Lighting Educational Committee's campaign.

The public frankly prefers electric light to any other illuminant, but few households seem to have any clear understanding of how it should be used, for the good of their own eyes. There is great need for education—in a simple, understandable and intelligible way—and it is for this purpose that the home-lighting campaign has been organized. Nearly three thousand communities are now ready for the local essay contests, and the movement has clearly become the greatest single co-operative educational adventure upon which electrical men have ever embarked. It deserves the

heartiest support from all electrical interests, both in service and in the money contributions that are vital to the fulfillment of so ambitious a project. There will be no misunderstanding in America as to the effect of electric light upon eyesight, once the people appreciate the importance of using incandescent lamps properly.

Where Shall We Look for Executives?

VACATIONS over, the halls and lecture rooms of our colleges and technical schools are again filled with aspiring students, many of them specializing in electrical engineering. No doubt a question has come up in the minds of some as to their future. What prospects are in store and what are the chances for success? While that is not the highest view to hold regarding education, nevertheless many students and their parents do regard a technical education as a means to an end. To these it may be surprising to learn that in the electric light and power business alone there is a lack of men for executive and administrative situations paying high salaries.

Many public utilities would grow more rapidly if this want could be filled. Over and above this, investigation shows that the number of graduates of engineering and technical schools is not sufficient to fill the executive places in industry, even granting that all of them were fitted for administrative work. It must be recognized, however, that a good technical expert does not always develop into a good executive, and while there is need for technically trained men, there is greater need for technically trained men with executive ability; that is, men possessing, besides a college degree, character, energy, personality and, above all, human qualities. There is no course guaranteed to impart these qualifications to the student. They must be acquired outside the classroom, but lacking them material success of the highest order is not easily attainable. Character is essential to leadership, and students should be impressed with that fact.

Unified Broadcasting in Great Britain

THE British Post Office controls all communication by mail, wire or radio in Great Britain and for a long time obstructed the development of broadcasting. In 1922 it relinquished for a period its rights in the practical developments of the art and gave an opportunity to a combination of radio companies called the British Broadcasting Company.

Under the direction of this company broadcasting has become very popular. More than a million licenses have been granted for receiving stations, sixteen hundred radio dealers are in business, and nineteen broadcasting stations have been built or are under construction. The prices of sets have been fixed, license fees and royalties have been established, and the industry has been protected by an ironclad clause prohibiting the use of any equipment not made in Great Britain. Even policies in regard to the length and contents of program have been established under the rigid censorship exercised.

This development in Great Britain is in striking contrast with the growth of broadcasting in this country, where the game has been open to all and little standardization has been had. Although many have conceived the idea of a nation-wide radio industry of the type developed by the telephone, none has attempted to carry out such a program. Thus an unorganized competitive condition exists which creates an environment stimulating to development but of which the ultimate effects are difficult to predict.

Many respective advantages and disadvantages of these contrasting methods of giving radio service can be pointed out, but only time will tell which will prove better and more economical from a service standpoint. In the meantime it is interesting to observe a government bureaucracy in England doing work usually done by private monopolies in the development of American industries.

Hysteresis and Losses from High-Voltage Corona

IT IS difficult to picture a mechanical analogy to the phenomenon of magnetic hysteresis. The nearest approach to such a picture would appear to be a mechanical force acting on a particle immersed in a medium having both elastic and viscous properties. Such a system, if the force were periodic, would consume energy which would have to appear in the medium in the form of heat. The loss due to magnetic hysteresis is commonly assumed to be caused by some type of friction or viscosity which acts between the molecules or the atoms of the magnetic substance. The motion of orientation of molecular magnets is, therefore, retarded and leads to some form of frictional loss of energy.

As regards the explanation of magnetic hysteresis, little or nothing definite is known. It is of interest, however, to learn from recent work in this field that in certain types of iron the losses due to hysteresis have been very greatly reduced by further refinements of purification, leading to the suggestion that the hysteresis loss itself may be largely due to impurities in mixture with the principal magnetic material.

There are apparently no other natural manifestations of hysteresis loss which possess the typical characteristics of magnetic hysteresis in any pronounced degree. The losses in dielectrics subjected to high alternating electric fields are frequently spoken of as due to dielectric hysteresis. The parallel between magnetic and dielectric behavior which can be drawn in so many other instances naturally suggests the occurrence of a dielectric hysteresis. This conception is strengthened, in the light of the recent magnetic work referred to, by the generally accepted fact that dielectric absorption is caused by a mixture of dielectrics and, therefore, by impurities. There are, however, a number of facts about dielectrics which would seem to indicate that losses in them do not partake of a hysteretic character. Dielectrics, for example, do not take on a permanent polarization, and it has not been possible to observe the parallel of magnetic coercive force. Dielectric absorption and dielectric conductivity are apparently sufficient to account for the losses in dielectrics.

The paper by Prof. H. J. Ryan to be presented at the Pasadena convention of the A. I. E. E. suggests that the losses due to the high-voltage corona on transmission lines have a hysteretic character. His suggestion is due to the shape of the corona power curve taken by means of the cathode-ray oscillograph, which gives curves, plotted between voltage and electric

charge, in the form of closed cycles. The shape of these cycles is quite suggestive of the well-known hysteresis loop. The parallel, however, does not appear to extend much further, unless we are to consider the ordinary loss due to the passage of current over resistance as having a hysteretic character. In the case of corona in air we undoubtedly have a case of a very much lower grade of conductivity than obtains in a metallic conductor, and to this extent the losses which take place when molecular ions pass through the air may possibly be considered as being due to internal molecular friction. It is undoubtedly this point of view which has led Professor Ryan to his interesting suggestion.

The Central Station's Attitude Toward the Refrigerator

ALTHOUGH many managers are optimistic over domestic electric refrigeration, it is felt in some quarters that others of them are unnecessarily retarding the development of this most desirable load and withholding a service for which the public will be most grateful. This, it is claimed, is due to the fact that many executives seem to feel that they must conduct an extended personal investigation and decide for themselves all the problems of refrigeration engineering before they are willing to sell equipment that has already proved itself a success in other cities.

It is interesting to consider that this is not an unnatural attitude on the part of an electric public utility manager—indeed, it is traditional—the reason being that the approach of central-station men to a new appliance is always first that of the buyer rather than the seller. Before he will buy his natural inclination is to sit back and force the manufacturer to overcome his resistance. To some extent this is well for the protection of the service and the public. It is a question, however, whether the public would not be sometimes better served were the utility more quickly to recognize the popular desire for such a convenience as the household refrigerator, for example, investigate the conclusive experience in other cities and get promptly behind the new device with the enthusiastic promotional instinct of the seller. After all, the best time for people to enjoy new benefits of electric service is *now*, and the service should be made available as soon as possible.

More Lumens on the Work Plane than Are Generated by Light Sources

OCCASIONALLY measurements of illumination intensities reveal the fact that the total lumens incident upon the floor or work plane exceed the total lumens emitted by the light sources. This usually appears startling and contrary to physical laws. Superficially it smacks of getting something for nothing and bears an analogy to perpetual motion. However, such a condition is neither impossible nor defiant of physical laws. In practice it is a good advertisement of the value of surfaces of walls and ceilings having high reflection factors because the condition can only arise where the surroundings have such factors. The ratio of the total lumens incident on the work plane to the total lumens emitted by the light sources is termed utilization factor. When the condition under discussion obtains the utilization factor is greater than unity.

If a light source having a luminous intensity of one candlepower in all directions is placed at the center of a hollow sphere having a radius of one foot, the intensity of illumination at the inner surface of the sphere will be one foot-candle if the spherical surface is covered with black velvet. If the inner surface of the sphere is painted with a good white paint having a reflection factor of 80 per cent, the illumination intensity at the inner surface will be 5 foot-candles. Thus 400 per cent of the light which reaches the walls of the spherical room is due to multiple reflections of light by the white walls.

If the sphere were replaced by a hollow cube, virtually the same results would be obtained. In practice rooms have windows which permit light to escape and have floors and equipment which are not painted white. If the room is large, only a small proportion of the total light is absorbed by them. Furthermore, utilization factor is based upon the percentage of total light which is incident upon the floor (or horizontal work plane), which is only one-sixth of the total inclosing surface when the room is cubical. If the floor is light-colored, or if the work spaces are covered with white material, a great deal of light will be reflected upward. Much of this will be returned by reflection from a white ceiling. These multiple reflections add light to the work plane. Finally, the lighting units must be efficient and must direct most of the light upon the work. Utilization factors greater than unity are likely to occur only in large rooms having walls and ceiling of high reflection factors, unusually light-colored floors and work spaces, an efficient direct-lighting system and few windows and dark-colored areas where light may be lost. The necessary combination is rarely found in practice.

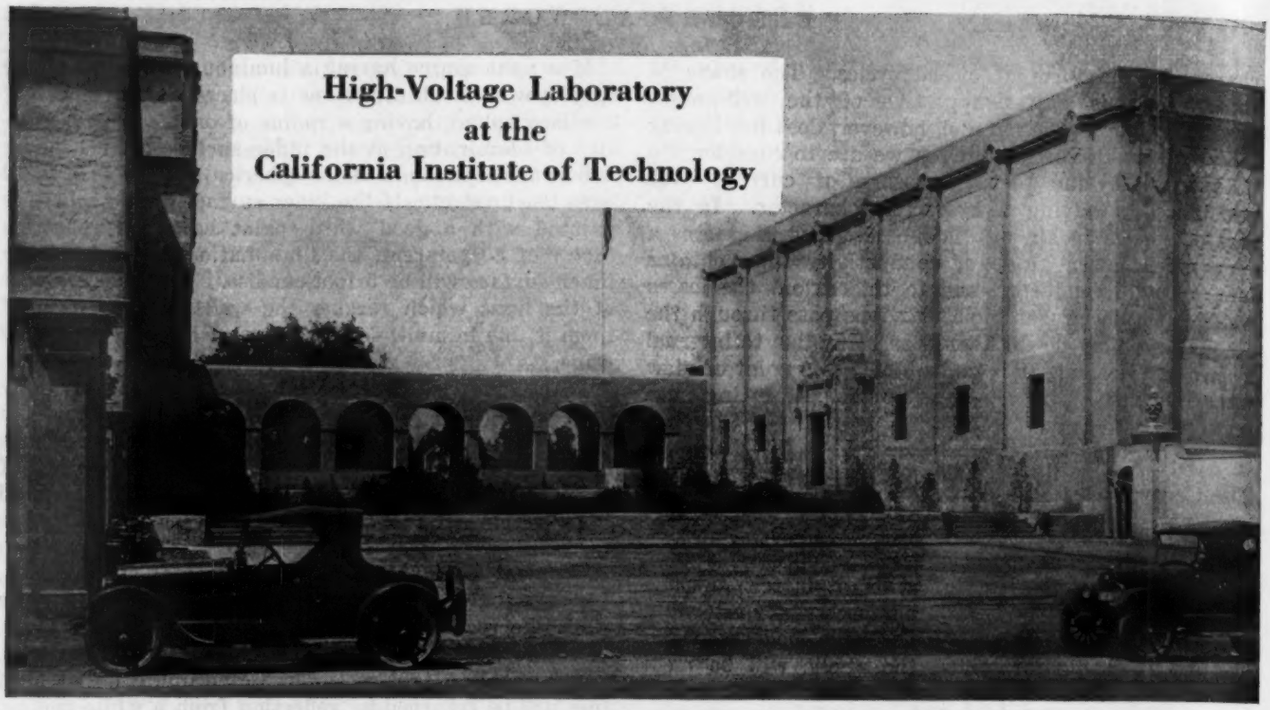
Value of Daily Heat Balance

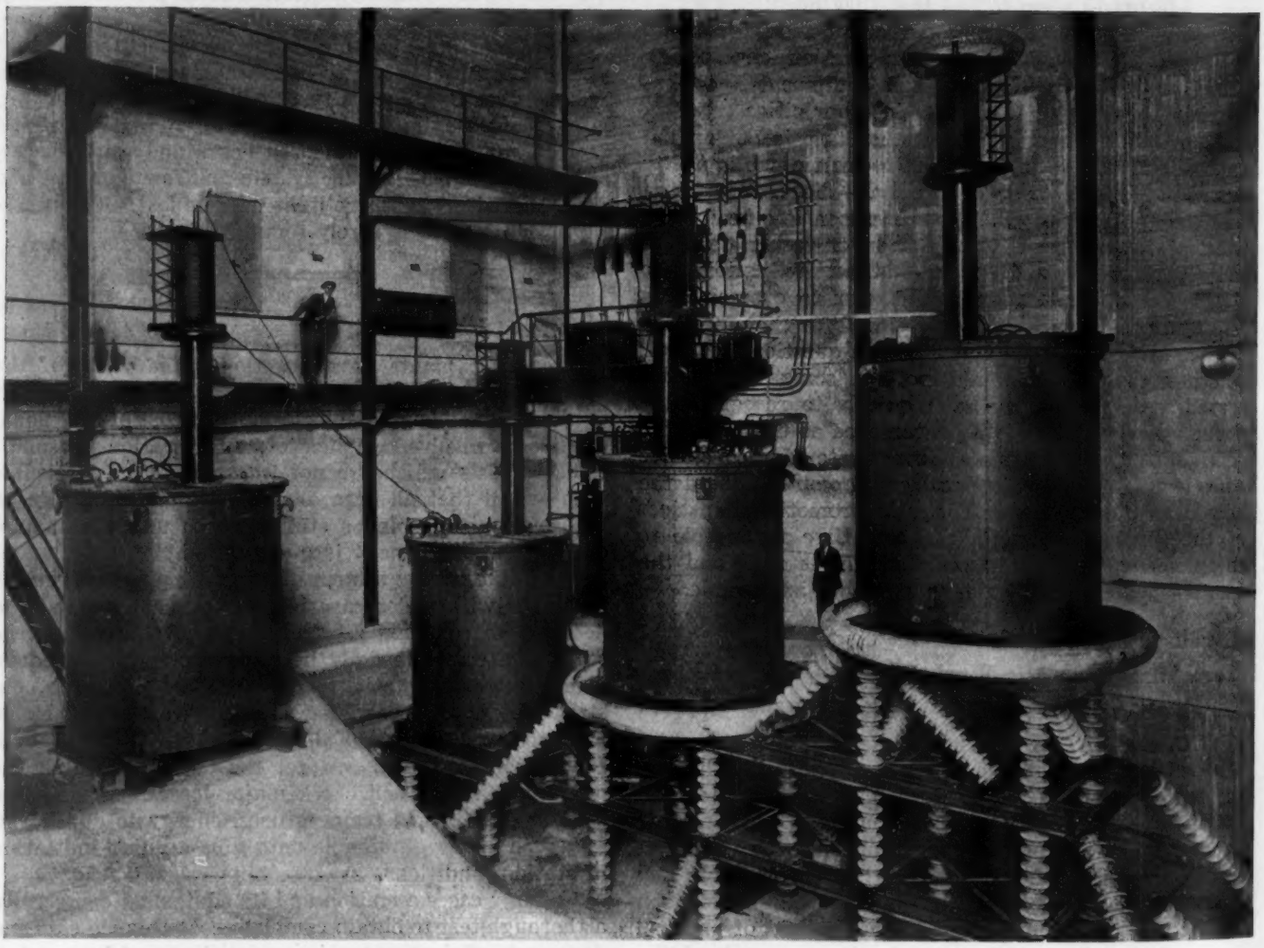
SMALLER plants have questioned the value of the daily heat balance. The comment is often made that the added metering equipment and the cost of additional attendants involve complications in operation and additions to costs which are not warranted. In particular it is stated that all data are *ex post facto* and are of little value in keeping a station keyed up to maximum efficiency at the time it is in operation.

The value of any system of checking plant operations increases with a decrease in time element and with a decrease in complexity, and for all but the very large stations a complete daily heat balance seldom is advisable. But every station can well afford to keep a constant check on those losses which are most variable and most easily controlled. With the installation of a few meters one man can get the data and watch the operations which will check major losses. Coal in the ashes, CO_2, flue-gas temperatures, energy to auxiliaries and such easily obtainable data give a quick indication of station conditions.

In many cases a station and its equipment can receive a thorough test to obtain complete heat-balance data under most efficient operating conditions. Afterward it is only necessary to take easily obtainable data for checking against the complete test results and thus compare actual and possible operating efficiencies. Every plant can well afford to study the possibilities of some form of daily check on operations. The losses in a steam-power plant are well worth while controlling in view of present fuel prices.

High-Voltage Laboratory at the California Institute of Technology





THE building housing the equipment of this 1,000,000-volt laboratory has a fabricated steel frame embedded in reinforced concrete. At one end of the building there is an office, lavatory, photographic dark room and storeroom for small apparatus. The roof slab of these rooms furnishes a large floor upon which is mounted a 20-kw. Poulsen arc set for obtaining power at high frequency.

On a level with the ceiling of these rooms (15 ft. above the floor) is a runway or observation gallery along the entire west side of the building. There is also an observation gallery at the 30-ft. level along the wall and one built in the roof trusses directly over the center of the room. The floor is 64 ft. x 138 ft. and the lower members of the roof trusses are 48 ft. above the level of the floor. Adjoining the east side of the laboratory there is available a transmission line 1,000 ft. long.

The testing equipment consists of four 250-kva., 250-kv. transformer units. Unit No. 1, at the left, is standing on the floor. Units Nos. 2, 3 and 4 are each mounted upon steel framework and are at potentials of 25 kv., 500 kv. and 750 kv. respectively above ground. Each stack of supporting insulators is made up of seven units.

Dielectric Strength of Insulation

Determination of the Influence Exerted by Time and Frequency—Tests Are Made on Individual Insulation Materials for Transformers—Effect of Series Grouping Is Also Established

By V. M. MONTSINGER
General Electric Company, Schenectady, N. Y.

VIRTUALLY all insulating materials have the characteristic that their dielectric strength is lowered with either time of voltage application or an increase in the frequency of the applied voltage. The reason for this is that these materials have a dielectric loss composed of hysteresis and ohmic losses which in turn cause the insulation to heat up. An increase in frequency increases the hysteresis loss, while time for any given frequency has the effect of storing up the heat. In the former case, if the frequency is extremely high, the dielectric strength may be reduced for any given time to a very low value as compared with that for, say, 60 cycles, because the hysteresis loss is increased many times. In the latter case, for any given frequency, time has the effect of decreasing the strength until the point is reached where the dissipation of loss, or heat, is equal to that generated. Generally speaking, this point is not usually less than approximately 50 per cent of the value at which failure occurs after one minute of time. In other words, solid insulation, if not too thick, will generally stand for several hours and perhaps for an indefinite length of time the voltage stress of at least 50 per cent of its one-minute dielectric strength, and in some cases it will stand for long periods of time values as high as 80 or 85 per cent of its one-minute strength. The average treated material, however, will stand about two-thirds of its one-minute strength.

The relation of dielectric strength (in kilovolts) of solid insulation versus time can, for practical purposes, be expressed by an equation of the form

$$\text{Kv.} = A\left(a + \frac{1-a}{\sqrt[n]{T}}\right) \qquad (1)$$

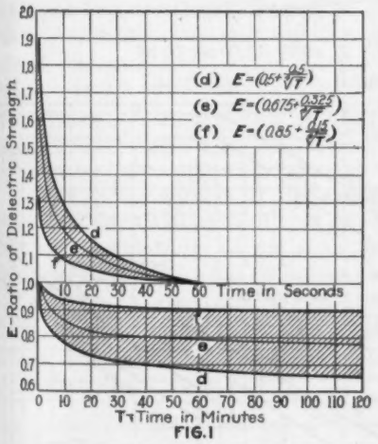


FIG. 1

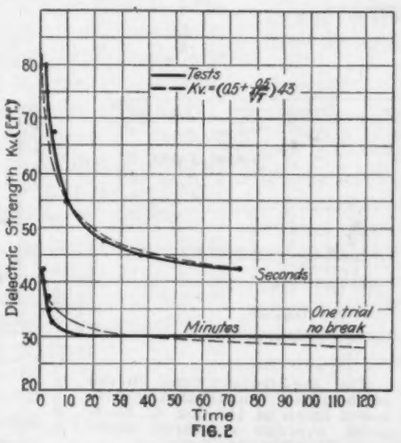
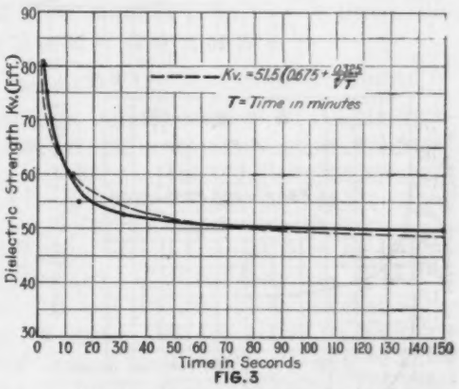


FIG. 2



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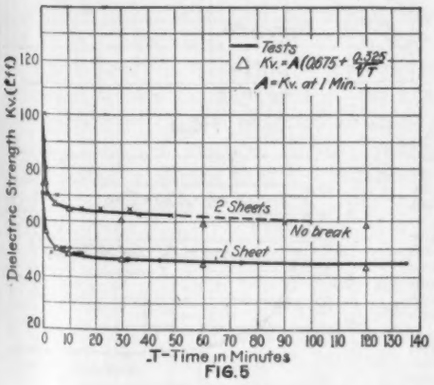

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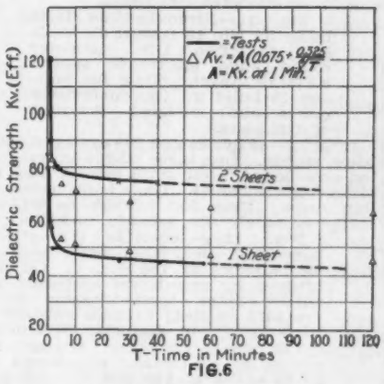

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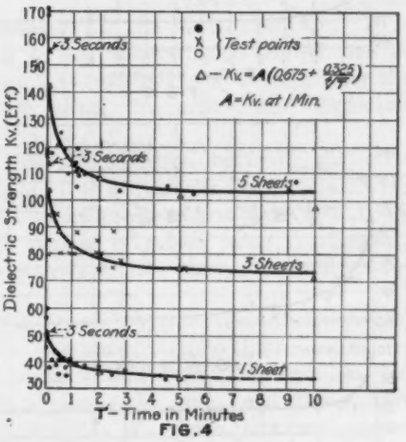


FIG. 4

STRENGTH-TIME CURVES OF VARIOUS INSULATIONS USED IN THE MANUFACTURE OF TRANSFORMERS

Fig. 1.—Strength-time curves plotted from formula:

$$E = a + (1-a)/\sqrt[n]{T}$$

Fig. 2.—60-cycle strength-time curve. One layer of 0.0935-in. oil-treated pressboard in oil at 25 deg. C. Each point average of ten tests. Time for voltage to build up (approximately one second) included. 2-in. diameter electrodes.

Fig. 3.—60-cycle strength-time curve. One layer of 0.0935-in. oil-treated pressboard in oil at 75 deg. C. Each point average of ten tests. 2-in. diameter electrodes. Time for voltage to build up (approximately one second) included.

Fig. 4.—60-cycle strength-time curves of 0.0935-in. oil-treated pressboard in oil at 100 deg. C. Two 4-in. diameter electrodes. Each test shown. Time shown from instantaneous voltage (rapidly applied) became constant until failure.

Fig. 5.—Strength-time curves of 0.0935-in. oil-treated pressboard in oil at 100 deg. C. Each point average of three tests. 4-in. diameter electrodes.

Fig. 6.—Strength-time curves of 0.0935-in. oil-treated pressboard in oil at 25 deg. C. Each point average of three tests. 4-in. diameter electrodes.

in which A = the one-minute strength in kilovolts, a = ratio of strength for infinite time to the one minute strength, and T = time in minutes.

Fig. 1 shows strength-time curves plotted from equation (1) for three different values of a, that is, maximum, average and minimum, as found from tests made on various materials used in the manufacture of transformers. It will be noted that for the first few seconds a small change in time makes an appreciable difference in the strength. It is important, therefore, when test-

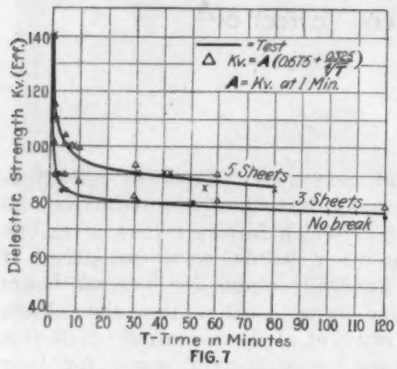


FIG. 7

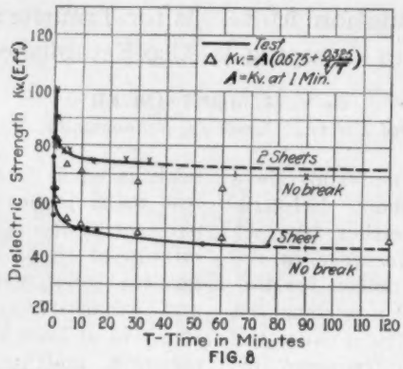


FIG. 8

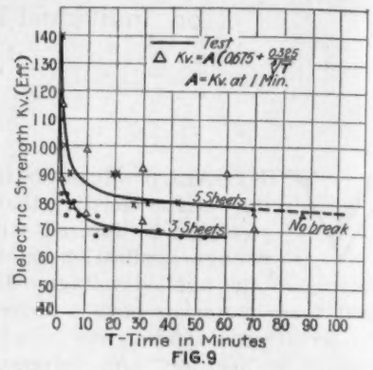


FIG. 9

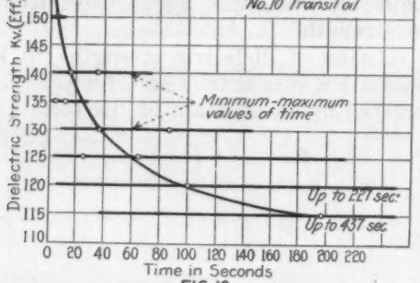


FIG 10

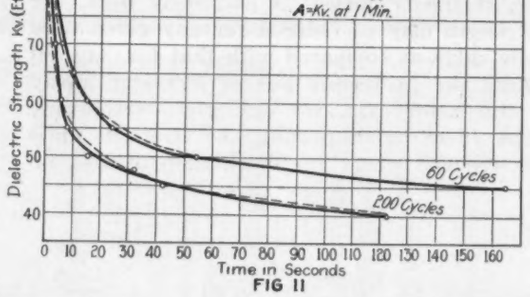


FIG 11

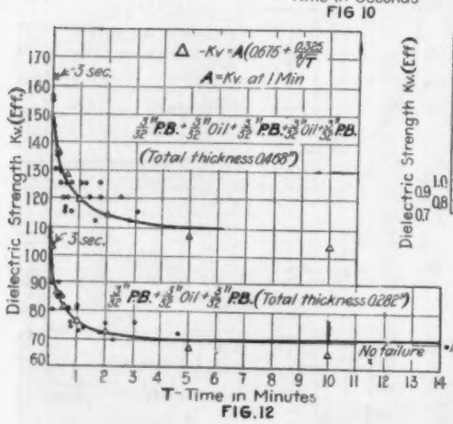


FIG.12

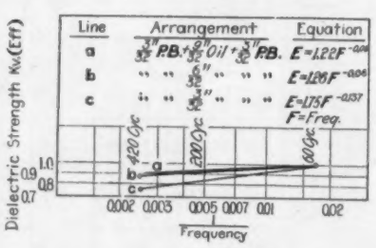


FIG 15

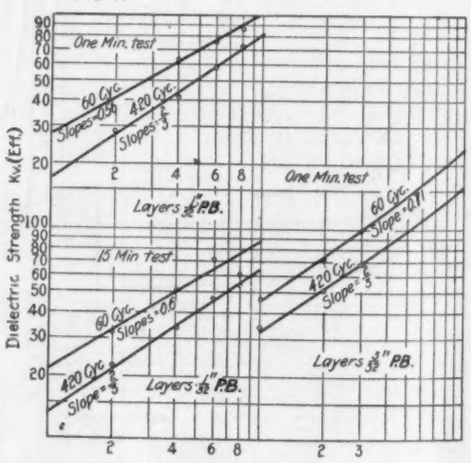


FIG.14

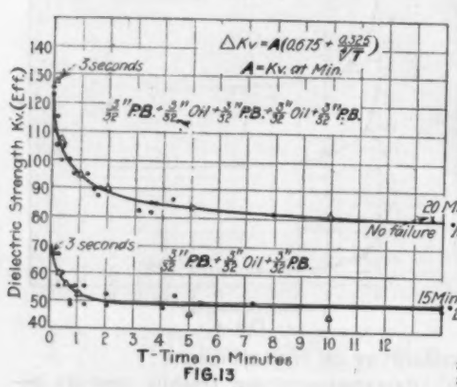


FIG.13

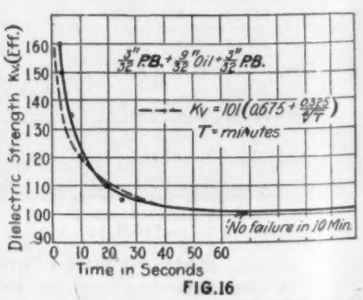


FIG.16

Fig. 7—Strength-time curves of 0.0935-in. oil-treated pressboard in oil at 25 deg. C. Each point average of three tests. 4-in. diameter electrodes.

Fig. 8—Strength-time curves of 0.0935-in. oil-treated pressboard in oil at 75 deg. C. Each point average of three tests. 4-in. diameter electrodes.

Fig. 9—Strength-time curves of 0.0935-in. oil-treated pressboard in oil at 100 deg. C. Each point average of three tests. 4-in. diameter electrodes.

Fig. 10—Strength-time tests made on No. 10 transil oil at 25 deg. C. Two 4-in. diameter round edge electrodes spaced 0.375 in. apart. Time for voltage to build up (approximately one second) included. Average of ten tests.

Fig. 11—60 cycles and 200 cycles strength-time curves. One layer 0.0935-in. oil-treated pressboard in oil at 25 deg. C. Two 4-in. diameter electrodes. Each point average of ten tests. Time for voltage to build up (approximately one second) included.

Fig. 12 — 60-cycle strength-time curves of oil-treated pressboard and oil in series at 100 deg. C. Oil ducts bridged by pressboard spacers. Time shown from instantaneous voltage (rapidly applied) became constant until failure. 4-in. diameter electrodes.

Fig. 13 — 420-cycle strength-time curves of oil-treated pressboard and oil in series at 100 deg. C. Oil ducts bridged by pressboard spacers. Time shown from instantaneous voltage (rapidly applied) became constant until failure. 4-in. diameter electrodes.

Fig. 14—Effect of frequency and thickness on dielectric strength of pressboard at 25 deg. C. 4-in. diameter electrodes. Tests made in 1914. Voltage increased uniformly at rate of approximately 5 kv. per time given in oil.

Fig. 15—Effect of oil in series with solid insulation on ratio of dielectric strength at different frequencies. 4-in. diameter electrodes. Points taken from data in Table V.

Fig. 16—60-cycle strength-time curve of solid insulation and oil in series at 25 deg. C. Average of ten tests. 4-in. diameter electrodes. Time for voltage to build up (approximately one second) included. Material $\frac{3}{32}$-in. oil-treated pressboard.

ing materials that sufficient time be taken, so that a small error in time will not cause a large variation in the breakdown strength. On the other hand, in commercial testing the length of time cannot be made too great on account of the expense involved.

Another case where the influence of both time and frequency has a very important commercial bearing is in making induced-voltage tests on transformers. For instance, if the transformer is permanently grounded on one end of the line or at the neutral point, the standard insulation test must be made by inducing the necessary voltage across the windings. If the transformer is single-phase and for a grounded Y system and it is necessary to impose a voltage strain on the end of the winding equal to twice line voltage, the induced voltage must be 3.46 times the single phase or line to neutral voltage of the system. It is usual practice, however, to give transformers for this class of service an induced-voltage test of 2.73 times the line to neutral voltage. Whether the transformer is of single-phase or three-phase rating, the frequency at which the induced voltage test is made must be at least twice the normal frequency; otherwise the exciting current becomes excessive. In cases where the units are very large the frequency must be several times the normal value. It is in these cases that the question of frequency and time of voltage application is a serious matter, because, as will be shown later, the strain imposed at the higher frequencies, for the same length of time, is very severe as compared with the lower and normal frequency strains. The natural result is that unless the time is reduced the amount of insulation must be increased above that which experience has shown to be satisfactory. This, of course, means that the transformers would be more expensive than necessary to give satisfactory and adequate service.

This article gives representative* results of a large number of tests made by the writer within the last year on solid insulations, built-up insulations of solids and oil and insulations of oil alone to determine the relationship between time of voltage application, frequency and dielectric strength. From these results it is shown how to choose the time for the higher frequencies to make the test equal to a standard one-minute test at the normal frequency.

Effect of Time on Dielectric Strength

Fig. 2 shows a strength-time curve of a single sheet of $\frac{1}{32}$-in. pressboard in oil at 25 deg. C. This curve checked best the 0.5 value of a in equation (1). Fig. 3 shows a strength-time curve of the same material as in Fig. 2 except that it is in oil at 75 deg. C. This curve checks best the average (0.675) value of a in equation (1). Fig. 4 shows that the shapes of the curves are about the same for various thicknesses of pressboard in oil at 100 deg. C. Figs. 5, 6, 7, 8 and 9 give mainly the effect of long periods of time on the dielectric strength of various thicknesses of pressboard at different temperatures. While a sufficient number of tests were not made for short intervals of time when these samples were tested—in 1917—to make them of very much value from zero to approximately one minute, yet they give valuable data on the effect of time, ranging from about one minute to about two hours' time, on the dielectric strength.

*For further data and details see "Effects of Time and Frequency on Insulation Tests of Transformers," by V. M. Montsinger, *A. I. E. E. Journal*, March, 1924.

Table I gives for any given frequency the relation between time and dielectric strength of the average varnished or oil-treated insulating materials. These values are based on equation (1), in which $a = 0.675$. The one-second ratio strength values should be considered as very approximate, since it is practically impossible to make reliable tests for so short a time on account of the difficulty of applying an instantaneous voltage without producing a surge.

TABLE I—EFFECT OF TIME ON DIELECTRIC STRENGTH OF SOLID INSULATIONS

Time		Ratio of Dielectric Strength to Strength for	
Sec.	Min.	One Minute	One Second
1	0.0167	1.59	1.00
3	0.05	1.36	0.855
5	0.083	1.28	0.805
10	0.167	1.18	0.74
20	0.333	1.105	0.695
30	0.50	1.062	0.67
60	1.00	1.00	0.63
..	2.00	0.95	0.60
..	5.00	0.89	0.56
..	10.00	0.86	0.54
..	30.00	0.82	0.515
..	60.00	0.79	0.50
..	120.00	0.77	0.485
..	Infinity	0.675	0.425

Transil Oil.—Fig. 10 gives the results of time tests made on No. 10 transil oil. Although oil when tested without barriers of solid insulation in series with it is very erratic, this curve shows that the strength decreases quite rapidly for the first few seconds of voltage application and after this the rate of decrease slows up and apparently disappears after two or three minutes' time.

Effect of Frequency on Dielectric Strength

The first important point is: How do the strength-time curves made at different frequencies compare? It is, of course, well known that the dielectric strength decreases as the frequency increases, but are the curves of the same shape? Very careful tests were made at 60 cycles and 200 cycles on one layer of $\frac{1}{32}$-in. oil-treated pressboard. The results of these tests are shown in Fig. 11. Figs. 12 and 13 also show strength-time curves made at 60 cycles and 420 cycles on alternate layers of pressboard and oil in series. It will be noted that all of these curves are of approximately the same shape—i.e., they agree with the same equation. It is fortunate that this is so; otherwise it would not be possible to formulate a simple rule for determining the relationship between time, frequency and dielectric strength.

Fig. 14 shows that the relation between dielectric strength and frequency for any given time remains the same for different thicknesses of solid insulation. There is no logical reason why this same relationship would not hold for strength-time curves as well as for any given time.

Fig. 14 is also of interest from the standpoint of variation of dielectric strength with thickness of insulation. There appears to be a prevailing opinion that when standard metal electrodes are used the square root law generally holds. Wagner,† however, states that when wooden electrodes are used the rupture voltage is in direct proportion to the thickness of the tested material and independent of the size of the plate. The curves in Fig. 14 show that the power is generally

†Karl Willy Wagner, "The Physical Nature of Electrical Breakdown of Solid Dielectrics," *A. I. E. E. Journal*, December, 1922.

two-thirds. In fact, many other curves obtained with metal electrodes show that the exponent seldom falls below two-thirds, usually coming between two-thirds and three-quarters for treated material, more generally nearer the value of three-quarters for varnished insulations such as varnished cambrics, etc. Untreated dry paper, however, has an exponent close to unity.

Table II shows the variation of dielectric strength

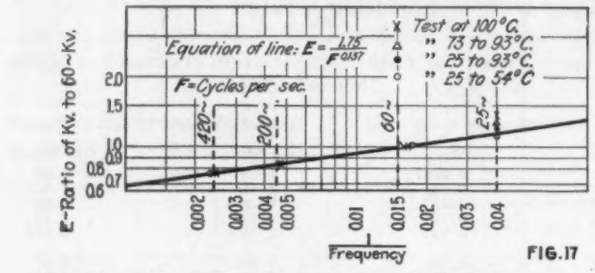


FIG. 17

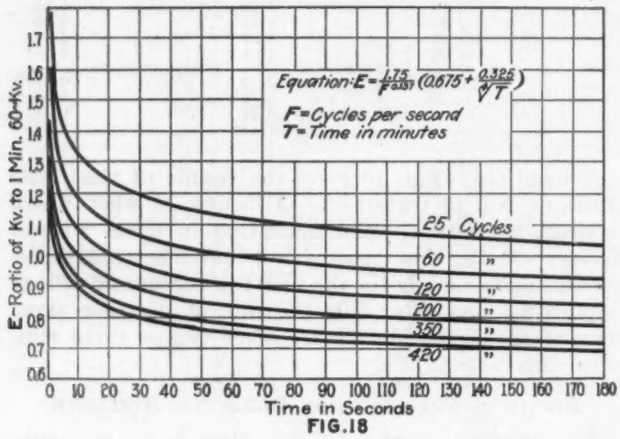


FIG. 18

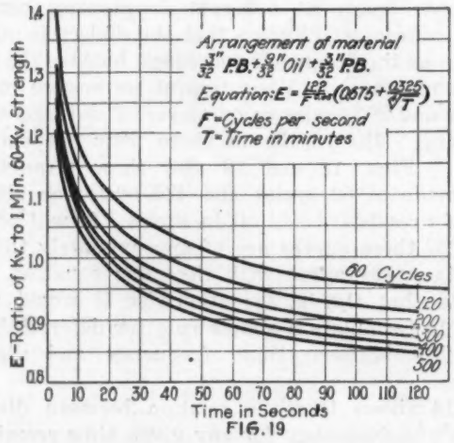


FIG. 19

CURVES SHOWING EFFECT OF FREQUENCY ON DIELECTRIC STRENGTH

Fig. 17—Effect of frequency on ratio of dielectric strength of solid insulation.

Fig. 18—Effect of frequency and time of voltage application on dielectric strength of solid insulation.

Fig. 19—Effect of frequency and time of voltage application on dielectric strength of pressboard and oil in series.

of various layers of pressboard tests at 25, 60, 200 and 420 cycles. When these results are plotted on double log paper (Fig. 15), with ratio of kv. to 60-cycle kv. as ordinates and with reciprocal of frequency as abscissas, it will be seen that (except for the 25-cycle points near 100 deg. C.) the points fall on a straight line. The equation of this line is $E = 1.75F^{-0.137}$ (2) in which E = the ratio of strength to 60-cycle strength and F = the frequency in cycles per second.

Table III gives for any time the relation between frequency and dielectric strength of the same materials applying to Table No. I. These values were calculated by the equation $E = 1.75/F^{0.137}$.

Table IV shows that the dielectric strength of oil is practically the same at both 60 cycles and 420 cycles.

Since transformer insulations usually have some oil in series with the solid material, it would not be correct to base the time of voltage application at the higher frequencies on tests made on all-solid insulation. Fig. 16 gives the 60-cycle strength-time curve on a barrier made up of two $\frac{3}{32}$-in. sheets of pressboard separated by one $\frac{9}{32}$-in. oil duct.

TABLE II—EFFECT OF FREQUENCY ON DIELECTRIC STRENGTH OF 3/32-IN. OIL-TREATED PRESSBOARD

Electrodes, 4 in. (10 cm.). Voltage increased uniformly at rate of 1 kv. per five seconds in oil

Layers	Frequency	No. Shots	Temp., Deg. C.	Kv. by Min.	Kv. by Voltmeter Max.	Kv. by Voltmeter Coil Average	Average Kv. by Spark Gap	Ratio of Kv. to 60-Cycle Kv.*
5	60	5	100	121	132	122.4	129	.....
3	60	10	100	90	94	92	94	.....
1	60	10	100	50	55	52.5	54	.....
3	60	10	26	73	101	97	99	.....
1	25	17	99	60	82	68.3	72	1.33
3	25	16	99.5	117	144	126.4	127	1.35
(ok) 3	25	10	99	120	138	126	126.5	1.345
5	25	10	27	104	117	109.4	110	1.11
1	420	10	100	40	45	42	41	0.76
3	420	10	100	72	76	75	43.5	0 78
3	420	6	27	76	80	78	76	0.77
1	200	11	98	36	41	39	43	0 80
3	200	10	100	70	74	72	80	0 85
(ok) 1	200	4	100	41	43	42	46	0 85
(ok) 3	200	4	99	78	80	79	87	0.925
5	200	3	100	96	98	97	108.5	0.84

* For same number of layers.

TABLE III—EFFECT OF FREQUENCY ON DIELECTRIC STRENGTH OF SOLID INSULATIONS

F—Frequency in Cycles per Second	E—Ratio of Dielectric Strength to 60-Cycle Strength
25	1.125
60	1.00
120	0.91
200	0.85
300	0.80
400	0.77
500	0.73

TABLE IV—60-CYCLE AND 420-CYCLE RUPTURE VOLTAGE OF NO. 10 TRANSIL OIL

Number of shots at each Frequency, 25. Temperature of oil, 28 deg. C.

Frequency, Cycles	Effective Kv. by Voltmeter Coil Min.	Max.	Avg.	Effective Kv. by Spark Gap
60	86	117	97	98
420	80	130	106.8	99

TABLE V—EFFECT OF FREQUENCY ON DIELECTRIC STRENGTH OF PRESSBOARD AND OIL IN SERIES

Electrodes, two disks, 4-in. (10-cm.) diameter; thickness of pressboards, $\frac{3}{32}$-in.

Case No.	Based on	No. of Pressboard Sheets	No. and Size of Oil Ducts	One-Minute Kv. Strength of Barrier 60 Cycles	420 Cycles	Ratio of 420 Cycles to 60 Cycles Strength
1	Figs. 12 & 13	1	(1) $\frac{9}{32}$-in.	76	52	0 685
2	Figs. 12 & 13	3	(2) $\frac{9}{32}$-in.	120	95	0.79
3	Average of 10 tests	2	(1) $\frac{9}{32}$-in.	111.7	98	0.88
4	Average of 10 tests	2	(1) $\frac{3}{32}$-in.	125.6	113.6	0.903
5	Average of 10 tests	2	(1) $\frac{1}{8}$-in.	129.8	117.3	0.903

TABLE VI—DURATION OF EQUIVALENT INDUCED-VOLTAGE TESTS OF TRANSFORMERS AT VARIOUS FREQUENCIES

(Taken from Fig. 19)

Cycles	Time in Seconds
60	60
120	39
200	28
300	23
420	19
500	16.5

Assuming that the dielectric strength of solid insulation and oil in series falls in a straight line when plotted against the reciprocal of the frequency on double log paper, the same as for solid insulation, the results shown in Table V and plotted in Fig. 17 give the effect of frequency between the limits of 60 cycles and 420 cycles on various arrangements of solid insulation and oil in series.

EFFECTS OF TIME AND FREQUENCY ON DIELECTRIC STRENGTH

The effects of both time and frequency can, of course, be expressed by multiplying the equation of time versus voltage by the equation of frequency versus voltage. That is, the ratio of dielectric strength, E, may be expressed by the general formula:

$$E = \frac{k}{F^n}\left(a + \frac{1-a}{\sqrt[4]{T}}\right) \qquad (3)$$

in which k and a are constants depending upon the kind and arrangement of materials, F is the frequency and T the time in minutes.

It has been shown that for the average treated solid materials $k = 1.75$, $n = 0.137$, $a = 0.675$. Based on these values and equation (3), Fig. 18 shows in curve form the relationship between the three factors dielectric strength, frequency and time of voltage application on solid insulations.

A barrier consisting of two ⅛-in. pressboard sheets separated by one ⅛-in. oil duct represents approximately the ratio of solid to oil insulation between the high-voltage and low-voltage windings of a transformer. By the curves in Figs. 15 and 16 the constants for this barrier have the following values: $k = 1.22$, $n = 0.05$, $a = 0.675$. Fig. 19 gives in curve form the relationship between strength, frequency and time for the barrier. Table VI gives the time to produce equivalent voltage strains at various frequencies on the above-mentioned barrier representing the insulation between the windings of a transformer.

Since all double induced-voltage tests on 60-cycle transformers must be made at not less than 120 cycles, a very convenient and workable rule if the standard time is one minute at 120 cycles, is to make the time inversely proportional to the frequency. This gives results very close to those given in Table VI.

Public Ownership and the American Plan*

System of Democracy in Government Built Up in United States Would Be Destroyed Were All Utility Companies to Be Taken Over and Administered Through Politically Controlled Bureaus

By HERBERT HOOVER
Secretary of Commerce

SENATOR LA FOLLETTE'S party proposes government ownership and operation of railway and other public utilities. In its immediate form this is a proposal that the government should buy and run the railways, electrical and other utilities, valued by official commissions at about forty billion dollars, with 2,700,000 employees, requiring two billions annually for bond interest, with an operating budget of ten billions per annum. To keep pace with natural growth these concerns must spend two billions of new capital yearly for extensions. This is a financial transaction and a venture into business of a magnitude never yet undertaken by any man or by any government, democratic or otherwise—except in Russia. Surely before we embark on such a voyage we should look into the possibility of profit, examine the chart of the place where we are going and consider the capacity of our vessel to carry the cargo.

Much of the present agitation is based upon conditions, not as they are today, but as they were a generation ago. There were then great abuses that called for remedy. Today there is scarcely a single utility that is not under public control through some governmental commission, local or national. These commissions today fix the rates, the issues of stock, the time tables, the car service, the profits. Our great national water powers are reserved to the government through fifty-year leases, under public control. And our commissions are not alone preventing abuse; they are maintaining initiative, enterprise and progress in our railway and other utilities, as witness their enormous growth and constantly improving efficiency and greater service.

Regulation has, through stabilizing rates, reduced the cost of capital by increasing the security for the savings of our people. From this security and within our generation there has come a new tide, and that is toward popular ownership as distinguished from government ownership. These enterprises are no longer owned or controlled by a few. One of our great service corporations has nearly four hundred thousand stockholders, another over two hundred thousand. The power companies have more than seven hundred thousand, and their bonds are directly and indirectly, through our mutual insurance companies and savings banks, in the hands of literally tens of millions of owners.

And from it all we have by and large evolved the best actual service to the people from utilities that there is in the world. It may not be perfect, but no one who has tried a European government railway or a telephone needs conviction of our superior service. Moreover, there is a diffusion of service and use among our people double and treble the proportions to the population of any other country. A larger proportion of our homes have electric lamps, a larger proportion have telephones. More of our people travel by rail and

*Abstracted from a radio address delivered from Washington on September 29 and broadcast over nationally interconnected stations.

more miles. We ship more goods per person, and our workmen have more power at their elbows than any other workmen in the world. The wages in our utilities give the highest standard of living and comfort on the earth. If our utilities were dominated by the malignity that some contend, these things would never have come about.

To whatever extent we have failed in control, whether it be through overcontrol or through insufficient control, it is a challenge to us to perfect our system. There have been mistakes and will be others. But I may say at once that if the American people have not the intelligence, if they have not the character, if they have not the political mechanism by which private competition can be maintained yet abuse can be prevented, then they do not possess the character or the political mechanism by which they can undertake the gigantic operation of these enterprises.

Effect of Public Ownership on Democracy

Neither our national nor our state governments are planned or equipped for the task of government operation of utilities. Nobody ever tried it on our stupendous scale of a continent, but there are governments which, in their smaller scope, do operate in some fashion some of their utilities. Since it is always in worse fashion than ours, their example is no temptation to imitation, but it does illustrate that some governments, on some scale, in some fashion, can operate some of them. But none of them has ever attempted to operate all the utilities, nor does any one of them possess 15 per cent of our railway mileage, or 6 per cent of our power, or 15 per cent of our telephones, and so on.

I would also have you observe that these governments all have much more concentrated power and responsibility than we have ever been willing to grant to our government. The fathers purposely made our government to a different model, for a different task. They divided power and responsibility where business must concentrate them. They thought liberty and individual rights worth safeguarding even at some cost of efficiency. But this very fact necessarily leaves to private enterprise many things which other nations can, if they prefer, do through government after a fashion. On the governmental side the result has been one of which we are as proud as other peoples are envious. On the business side the accomplishment far surpasses anything they know. Through the one we have liberty, through the other enterprise and decisiveness. Our form of government, which we have developed over 150 years, has assured us a measure of freedom and progress hitherto unparalleled in political history. The more we cherish it the less ready we should be to load it with a burden for which it was not built.

The very first and fundamental difficulty that our form of government presents is the relation of the states to the federal government. For in our plan we conceive that liberty requires a great measure of decentralization in authority. If these public utilities are to be operated by the federal government, we at once deprive the states of their measure of authority and control over railway, power, light and communication companies—we make the service in these states dependent upon the will of Washington. It is an impossible conception that we shall give the states the power to regulate the business of the federal government as they now regulate these services. Or are we going to divide the railways and power and communications into forty-eight systems, each ending at the boundary of its own state? Whichever we do will crack the timbers of our government.

If we pile these forty billions of business and 2,700,000 employees upon the government, one of two things happens. Either the 530 members of Congress or the hundreds of members of state legislatures become their real boards of directors, or, as it has been claimed, these great businesses could be placed in the hands of non-partisan commissions or government corporations, somehow free from politics and the dead hand of bureaucracy. Neither alternative will work. If we were to set up agencies so free from restraint of the Congress and legislatures as to accomplish these objects, we should have created gigantic despotisms controlling the wellbeing of our whole people—and incidentally controlling the very election of our officials. As a matter of fact, we can do nothing of this kind if we are to maintain a democracy. We cannot have a democracy and deprive our elected representatives of their control of government investment, their power to fix salaries and wages, their independence in the investigation of the conduct of public officials. The reservation of any or all of these powers renders any kind of a commission subservient to the members of legislative bodies, no matter what the theory is.

These legislative bodies would have to deal with group pressures striving for favors in rates. The relative rates will affect the prosperity of every city and every section, every group and every industry. States, counties, farmers, town dwellers, every group of manufacturers will press their representatives to secure an advantage, and legislators will inevitably honestly favor their constituents. Every experience to date indicates that the taxpayer will pay for the resulting concessions. Because the government had not the courage to increase railway rates during the war the taxpayer made up an operation deficit of $1,600,000,000. A neighboring government yielded last year to the demand for lower rates on the government railways; it is paying the deficit from taxes today.

By this vast venture that is proposed to us we would at once increase the total of national and local office holders up to about six millions. The rightful interest of this group is in higher pay, constantly better conditions of service and better standards of living. The rightful public interest will be to hold down rates and taxes. These interests will clash, and their clash must fight itself out not on grounds of economic bargaining between labor and employer, but in the political arena.

Higher Rates to the Public

Unless the federal or local governments can give the public lower rates, there is no use undertaking the gamble. If the government is to reduce rates, it must do so either by the saving of private profits or by reducing operating expenses or lumping them on the taxpayer. During the past four years the railways have on an average earned less than 4 per cent on the Interstate Commerce Commission valuation. Even if this value were reduced by 25 per cent, they would have earned only 5 per cent. Our electrical utilities are regulated at earnings between 6 and 8 per cent upon their invested capital. The government could not borrow the huge sums necessary at less than 5 per cent.

In a sale to the government the constitutional requirements would, for various legal reasons, probably

result in a much larger sum than the forty billion dollars of present valuations by commissions and others. Nor can the government operate as economically as private enterprise. If we take over nearly three million new employees into public service, we must put them under an air-tight civil service, to be hired by a separate commission and promoted by seniority, and at once we have created a bureaucracy.

POORER SERVICE AND HIGHER TAXES

Nor will the public secure better or more impartial service under government ownership. The action of all government officials must be limited by a vast amount of regulation and "red tape." Therefore, government employees never can yield that spirit of accommodation that employees of private enterprise must furnish in order to maintain the repute of their competitive enterprise and its standing in the community.

A much larger issue lies in the inequality with which facilities will be provided over this continent three thousand miles wide. It is mighty important to have cars and kilowatts when they are needed. The economic life of somebody is stifled every time they are not available. Every fit of national economy will cause them to fall behind future need. Every district and group of the politically weak will have to do without some measure of their need. Today there is remedy for failure in service; there is no remedy against the Government.

Another question worth examining is the direct and indirect tax burdens which will be imposed upon the public, assuming always that rates pay operating expenses and interest. The addition of forty billion dollars to the national debt differs much from the debts of many thousand of private enterprises now comprised in these public utilities. The failure of a single private enterprise is a loss to its owners only, but with this entire investment transferred to the government every citizen would pay every loss of capital, directly or indirectly from taxes or rates, whether he liked it or not. Today the combined utilities contribute about $600,000,000 in taxes to the federal and local governments.

The next question to examine is whether the employees would benefit by being incorporated into the government service. The first and foremost result of such an operation would be a dispute over the right to strike. In any event, under government ownership employees must in the final analysis bargain with legislative bodies, and bargaining will rest not upon economic need or economic strength, but on political potency.

INVENTION WILL DECLINE

The essence of progress is that we shall have new mechanical invention, new ideas in administration, new developments in service. The proposal that we are examining here would destroy all competition. By the same operation we destroy the competitive market for new invention and new ideas, for their value is determined by competitive bidding. Government utilities in other parts of the world get their technology from us. So far as I am aware no single vital invention has ever come out of government-owned utilities. If we are to assume that there will be no more need for else than routine operation, we may abandon this argument. But science is only at the threshold of its house of wonders. It may even solve methods of transportation that would cause the abandonment of railways to the taxpayer as it would have done to a nationalization of the stagecoach.

The classic domestic argument against all this is the postal service. There are, of course, conclusive reasons why that service must remain a public function. And it does carry the mails well, at a cost probably 25 per cent higher than private enterprise could do it. But remember that the postal service pays no interest upon the vast sum of capital invested in its equipment and buildings. It pays no taxes on these structures. And how is that capital investment in public buildings distributed? Notoriously on the reverse of business principles. How are the rates allocated to different classes of service? By the pressures of organized groups. Postal employees are always in difficulties with their board of directors—that is Congress—as to pay adjustments. We are here proposing to amplify the shortcomings inherent in the Postal Service in the direct ratio of the Post Office budget of $600,000,000 to an annual budget of $10,000,000,000 in the utilities, not with 300,000 employees but with 2,750,000 and a business of infinitely greater technology.

Our national shipping is a daily sample of all the arguments I have given, and more. We paid three billions of the taxpayers' money for a fleet—some part of it was truly for war purposes—but we have written it down 90 per cent in six years to $300,000,000; and if the accounts were based upon true costs, with interest and depreciation, we should find that we are losing over one hundred million dollars of the taxpayers' money a year in operating it. Yet private shipping is earning profits. Nor is this the fault of the Shipping Board; it is inherent in the system.

Our government has some necessary power interests of its own. The building by the government of great control dams, as on the Colorado, the St. Lawrence and elsewhere, whose primary functions are water supply, or control of flood, or irrigation, or navigation, and where power is a byproduct, is a far different thing from the government's going into power production and distribution as a business. Some of our municipalities are faced with these problems and sometimes they also have a desire for business adventure, but the withdrawal of more than four hundred municipalities from efforts to run utilities is itself indication that even under local concentration of authority the results are doubtful enough.

PATENT MEDICINE FROM EUROPE

We are asked to abandon all that we have builded as a land of opportunity by injecting into it an economic patent medicine from Europe. Socialism may have a place with some of the nations of Europe because of their failures to provide freedom, opportunity and service. It has no place with us. We are building here a form of social organization of our own. We differed with European ideals three hundred years. We have today in America the widest extended and most efficient utility services in the world. We have developed an effective method of controlling abuses. We contribute more to invention and improvement than all other peoples combined. We are asked to abandon all this and embrace new social ideas, increase our cost of service, decrease our national efficiency, undermine our democracy, destroy the fundamentals upon which our nation has become great. This is not progressive, for it is not progress. It is destruction.

Cost Data on a 6,600-Volt Rural Line

Line Expense with 250-Ft. Spans Using Aluminum Conductors Averages $1,215 per Mile—Outdoor 150-Kw. Substation in Atlanta, Ill., Built at a Total Expenditure of $4,940.48

By J. C. ROBINSON
General Manager Atlanta Electric Light & Power Company, Atlanta, Ill.

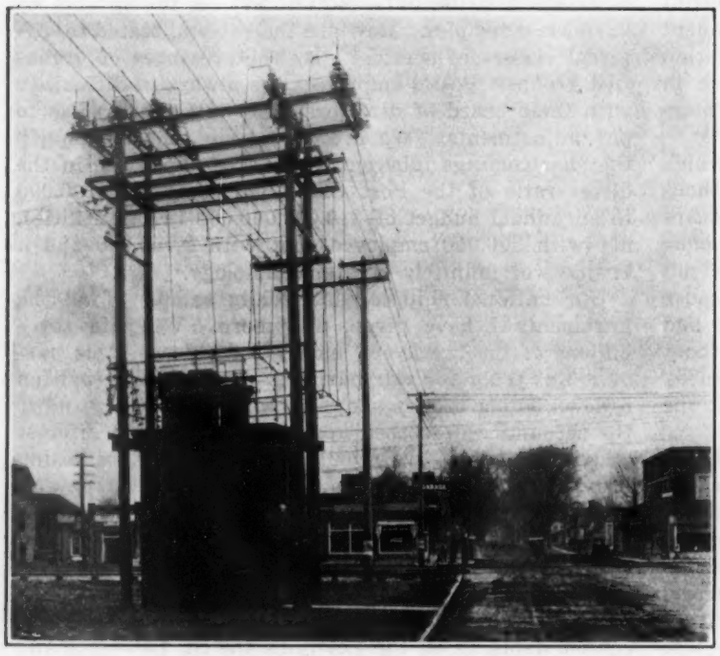


FIG. 1—THE OUTDOOR 100-KW. SUBSTATION IN THE CENTER OF ATLANTA, SERVING 564 CUSTOMERS

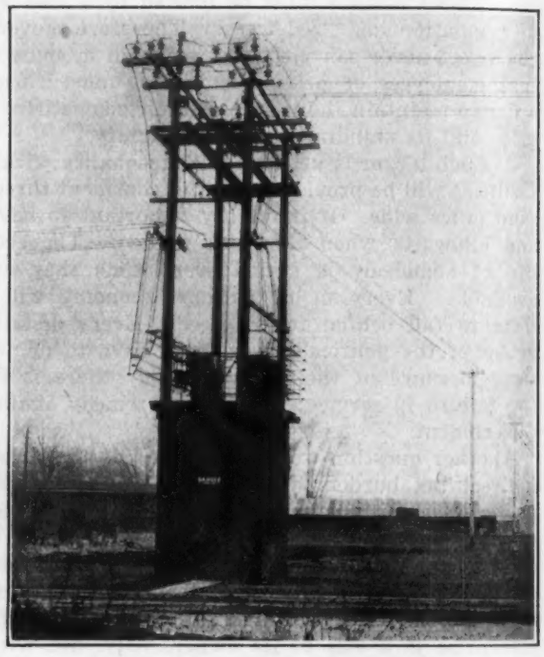


FIG. 2—A VIEW FROM THE NORTH SHOWING THE INCOMING TRANSMISSION LINE

UP FROM Lincoln to Atlanta, Ill., a 6,600-volt rural transmission line, 12.25 miles long, was built last fall at an average total cost of $1,961.32 per mile. This figure includes both the cost of the line and the cost of two substations. The line runs from the Lincoln Water & Light Company's plant northward through the rich corn-farming section of Logan County into Atlanta, which is the center of that district. Previous to August, 1922, energy for the territory has been generated at Atlanta; it was decided to discontinue the local plant and purchase power, allowing the Atlanta company to serve solely as a distributor. Negotiations with the utility at Lincoln led to contracts providing for the construction of this line.

Calculation of the line costs with various wire spans of both copper and aluminum showed that it would be more economical to use aluminum wire with 250-ft. spans. The line was then designed to deliver 150 kw. at Atlanta at 6,600 volts with a full-load line loss of 10 per cent.

In order to use the poles of the Illinois Traction System and the Lincoln Water & Light Company, the line was built in three sections. The first ran from the Lincoln substation on poles belonging to the Illinois Traction System for a little more than two miles, and thence for 3,300 ft. the line was placed on poles owned by the Lincoln Water & Light Company. On section 1 triple-braid weatherproof medium hard-drawn copper was used, while No. 4 hard-drawn bare wire was strung on section 2. These two sections, however, have a total mileage of only 2.78. On these sections the franchise rights were 80 cents per pole.

STRANDED ALUMINUM USED

The third and longest section was built with No. 2 stranded aluminum conductors with pole spacings of 250 ft. and running northward 9.45 miles to Atlanta. The cost of this section averaged $1,215 per mile. The general construction required 30-ft., 8-in.-top, class B Western red-cedar poles with ⅜-in. creosote butt treatment, while for corners and crossings the size was increased to 35 ft. and 40 ft., depending upon locations. For each mile of the main-line construction an "H" frame was erected and guyed as shown in Fig. 3. Insulator pin spacings were chosen as 18 in. because this spacing gave the best all-around construction for a four-wire line both as to strength and cost. If a couple of two-pin arms had been used, a 35-ft. pole would have been required in order to give proper ground clearance. Although the line operates at 6,600 volts, the insulators are rated at 13,000 volts to provide for future load requirements which might necessitate raising the line voltage to 11,000. The present circuit is three-wire, but four-pin cross-arms were chosen to allow four-wire distribution whenever needed. The

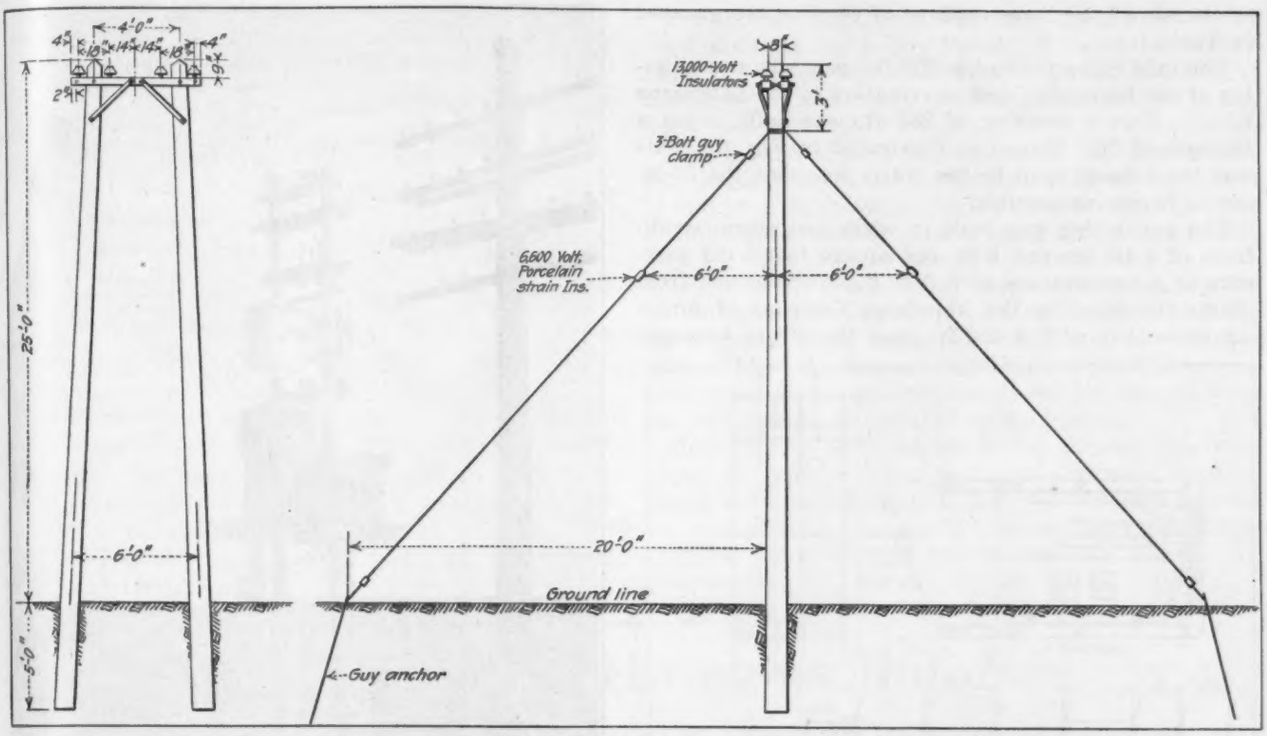


FIG. 3—CONSTRUCTION OF THE "H" FRAME ERECTED EVERY MILE AND GUYED IN TWO DIRECTIONS

TABLE I—COSTS OF LINCOLN-ATLANTA TRANSMISSION LINE—GROUPED IN THREE SECTIONS OF CONSTRUCTION

MATERIAL AND EQUIPMENT	Section No. 1		Section No. 2		Section No. 3	
	No.	Price	No.	Price	No.	Price
Poles						
35-ft., 7-in., top class B Western red cedar	1	$19.40	.....	.....	.....	.....
40-ft., 7-in. class B Western red cedar	1	21.30	.....	.....	.....	.....
45-ft., 7-in. top, class B Western red cedar	4	98.40	.....	.....	.....	.....
50-ft., 8-in. top, class B Western red cedar	7	184.25	.....	.....	.....	.....
55-ft., 8-in. top, class B Western red cedar	1	32.20	.....	.....	.....	.....
30-ft., 8-in. top, class B Western red cedar	.....	.....	.....	.....	191	$3,047.70
35-ft., 8-in. top, class B Western red cedar	.....	.....	.....	.....	1	19.40
40-ft., 8-in. top, class B Western red cedar	.....	.....	.....	.....	11	234.30
45-ft., 8-in. top, class B Western red cedar	.....	.....	.....	.....	11	270.60
50-ft., 8-in. top, calss B Western red cedar	.....	.....	.....	.....	4	111.00
Cross-Arms						
3½-in. x 4½ in. x 6-ft. Washington fir	100	103.31	62	$73.86	280	289.27
Cross-Arm Braces						
1 1/16-in. x 1 1/16-in. x 28-in. galvanized	200	17.88	125	11.18	520	49.76
Insulator Pins						
¾-in. x 11½-in. Pierce No. 90 spring-top pins	300	70.50	186	43.71	800	188.00
Porcelain Insulators						
13,000-volt Ohio Brass No. 10044	320	108.80	200	68.00	875	297.50
6,600-volt Ohio Brass No. 11630 strain	15	7.80	.....	.....	96	46.80
Hardware						
¾-in. x 12-in. through bolts	10	.97	50	3.58	200	14.36
¾-in. x 14-in. through bolts	90	7.22	.....	.....	25	2.01
¾-in. x 15-in. through bolts	.....	.....	15	1.27	.....	.....
¾-in. x 18 in. space bolts	20	2.82	30	3.82	90	11.45
¾-in. x 4-in. carriage bolts	200	2.84	125	1.78	560	7.95
¾-in. x 4-in. lag screws	100	1.99	62	1.23	255	4.98
2-in. x 2 in. x ¾-in. sq. washers	280	2.41	182	1.57	900	7.44
¾-in. round washers	200	1.06	125	.66	560	2.97
Guy Anchors						
6-in. Mathews anchors	.....	.....	.....	.....	60	105.00
7-in. Mathews anchors	10	26.00	.....	.....	25	65.00
Three-bolt clamps	30	5.48	.....	.....	175	31.94
⅜-in. guy wire	1,000 ft.	11.00	.....	.....	5,000 ft.	55.00
Wire						
No. 4 hard-drawn copper	.....	.....	1,260 ft.	186.56	.....	.....
No. 4 M.H.T.P. weatherproof copper	34,000 ft.	843.65	.....	.....	.....	.....
No. 2 standard aluminum	.....	.....	.....	.....	29 miles	2,960.81
Flat aluminum tie wire	.....	.....	.....	.....	125 lb.	39.43
Round aluminum tie wire	.....	.....	.....	.....	200 lb.	63.08
McIntyre joints	.....	.....	.....	.....	60	60.80
Grove clamps	.....	.....	.....	.....	24	8.64
Dead-end clamps	.....	.....	.....	.....	24	114.00
Wrenches	.....	.....	.....	.....	2	21.00
Local supplies	.....	.....	.....	.....	.....	134.06
Sundries, haulage, freight, engineering, banking	.....	222.10	.....	118.70	.....	1,208.12
Labor	.....	974.12	.....	235.45	.....	2,008.54
Illinois Traction System Material	.....	275.88	.....	.....	.....	.....
Total line costs	.....	$3,041.38		$751.37		$11,480.91

total costs of the three sections of the line are grouped in Table I.

The only exception to the 250-ft. span was at a crossing of the Kickapoo Creek, a tributary to the Sangamon River. Here a crossing of 285 ft. was built, using a four-guyed "H" frame, as illustrated in Fig. 6. This was the longest span in the entire line, but the 30-in. sag is hardly perceptible.

The entire line was built to withstand storm conditions of ½ in. ice and 8 lb. per square foot wind pressure at a temperature of 0 deg. F. Calculations from charts furnished by the Aluminum Company of America show that with a 250-ft. span the strain averages

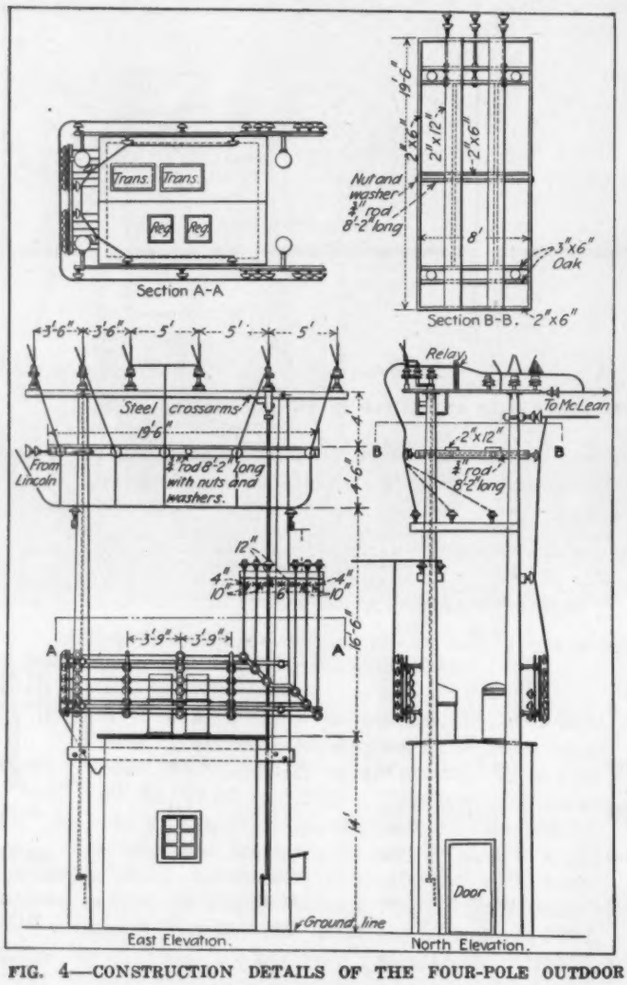


FIG. 4—CONSTRUCTION DETAILS OF THE FOUR-POLE OUTDOOR SUBSTATION IN ATLANTA

1,400 lb. per square inch, whereas the ultimate tensile strength for this size of wire is 2,660 lb. per square inch.

SUBSTATION CONSTRUCTION

At the Atlanta receiving end an outdoor substation was erected, illustrated in Fig. 1. The construction details are given in Fig. 4. For this 100-kw. four-pole substation it was necessary to purchase only one new transformer since one transformer was available from the old system of distribution. Satisfactory operation has been obtained so far with an open-delta connection, but the line has enough capacity behind it to warrant an additional 50-kw. transformer, should load conditions require this increase. Voltage regulation is provided by two 25-amp., 2,300-volt regulators. The equipment of this four-pole substation cost $3,730.08, which

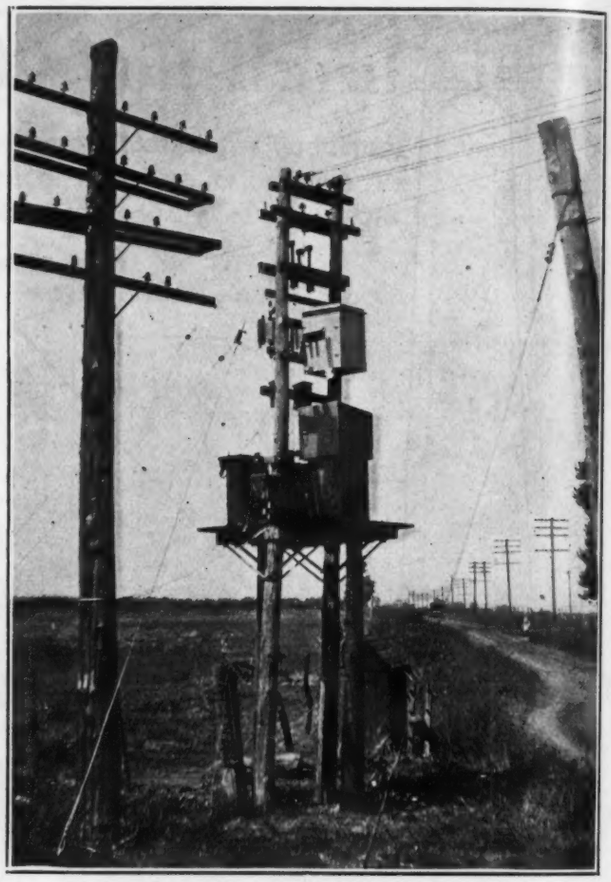


FIG. 5—THE OUTDOOR 40-KW. SUBSTATION FEEDING THE RURAL COMMUNITY IN McLEAN

includes the transformer, the regulator and the high-tension air-break switches. To this was added $1,210.76 for haulage, freight, engineering and labor, which brings the total cost of this substation to

FIG. 6—THE 285-FT. ALUMINUM WIRE CROSSING AT KICKAPOO CREEK, ATLANTA, ILL., COSTING $1,215 PER MILE

TABLE II—ITEMIZED COST DATA ON LINCOLN, ATLANTA AND McLEAN SUBSTATIONS

	No.	Lincoln	No.	Atlanta	McLean
50-kw. transformers, 13,200-6,600/2,300-volt	3	$1,132.50	1	$377.50	.....
25-amp., 2,300-volt, 10 per cent regulators					
High-tension air-break switch, three-phase	..	.....	2	2,600.66	.....
High-tension air-break switch, one-phase					
25-amp., 2,300-volt, 10 per cent regulator					
Lightning arresters, coils, etc....	..	.....	..	.....	$999.00
Complete metering equipment..					
Switchboard panel complete.....	1	633.00	..	.....	.....
Wire, potheads, steel angles and supplies	..	154.18	..	751.92	3.00
Sundries, haulage, freight, engineering, banking	..	303.10	..	755.20	214.75
Labor	..	314.81	..	455.56	57.33
Total substation costs	..	$2,537.59	..	$4,940.84	$1,274.08

$4,940.84. The itemized cost data are given in Table II. Adding the totals of the tables, it will be seen that the cost of the complete line installation was $15,273.66 and the complete total costs, including substations, $24,026.17.

The McLean substation was constructed to serve the rural districts north of Atlanta. This 40-kw. station (Fig. 5) is single-phase. The total cost, including a 2,300-volt regulator and the complete metering equipment, was $1,274.08.

The line weathered the storms of the past winter very successfully. An indication of its strength may be had from an incident which occurred while the State of Illinois was removing trees along the line's right-of-way for the new hard-road pavement running from Chicago to St. Louis. One afternoon a miscalculation in felling a tree caused it to land directly upon the transmission line. Although the short circuit thus formed blew the breakers at Atlanta, the line sprang back to its normal position again without damage when the tree was finally brought to the ground.

Credit must be given to D. W. Snyder, Jr., vice-president Lincoln Water & Light Company, who assisted in financing the line, and D. C. Wallace, operating engineer Bloomington & Normal Railway & Light Company, who designed the transmission circuits and substations.

Benefit of Synchronous Motors

Study Shows that This Equipment, Installed in Large Sizes, Effects Saving Without Preferential Rate—In Case Analyzed the Annual Saving Yielded Return of 15 per Cent on Increased Investment

By L. J. MOORE
Executive Engineer San Joaquin Light & Power Corporation, Fresno, Cal.

THE installation of synchronous motors by consumers has been receiving much consideration from power companies in recent months. Various schemes for inducing the consumer to install high-power-factor motors have been suggested. One factor which should not be overlooked in this connection is the saving to the consumer due to improved efficiency and power factor. That is to say, the saving gained is not all on the side of the power company. A study of the facts in the case shows that in many, if not in all, instances where motors are of reasonably large size the change to synchronous motors can be justified without a preferential rate.

A large consumer on the system of the San Joaquin Light & Power Corporation was considering a change from induction motors to synchronous motors. The installation amounted to approximately 1,000 kva. connected load operating under very steady conditions in an ice-making plant. Service was rendered through three 250-kva. transformers, the consumer being metered on the high-voltage side of the transformers. Engineers of the power company made a careful investigation of the situation and obtained the interesting data here presented.

PRELIMINARY TESTS

First, a series of tests were made on the plant which gave the results shown in the table in the next column. Based on these tests, the load in kilowatts and kilovolt-amperes with the present motors was determined for the four possible conditions of operation. The power factor of the various motors was determined from the above tests. An efficiency at full load for the 500-hp. motor of 88 per cent and an efficiency of 85 per cent for the 200-hp. motor were determined from the manufacturer's guarantees. The load in kw. and kva. if the two large motors were replaced with synchronous motors operating at guaranteed efficiency and unity power factor is also shown as follows:

RESULTS OF PRELIMINARY TESTS WITH SYNCHRONOUS MOTORS

	Kw. Input	Kva. Input	Power Factor
Test on entire plant (including transformers).....	686.0	925	74.2
Test on 200-hp. motor only.....	110.3	209	50.5
Test on 200-hp. motor and auxiliaries.....	193.0	349	55.0
Test on 500-hp. motor and auxiliaries.....	392.5	507	77.5
Test on 500-hp. motor only.....	328.0	387	85.0

With present induction motors:

	Kw.	Kva.
CASE I —Operation of both motors.....	650	875
CASE II —Operation of 500-hp. motor.....	500	605
CASE III—Operation of 200-hp. motor.....	180	329
CASE IV—Negligible load (under 50 kw.).....	...	...

With synchronous motors:

CASE I—A.—Operation of both motors.....	629	677
CASE II —A.—Operation of large motor.....	485	522
CASE III—A.—Operation of small motor.....	174	315
CASE IV—A.—Negligible load		

Necessary auxiliaries about the plant are included in each case.

The time the plant operated during the year 1923 with the various conditions of load was determined from the maximum demand meter charts which show the load in kilowatts for fifteen-minute periods for the entire year. These charts showed the following operation:

	Hours
CASE I —Both motors running	4,133
CASE II —Large motor running	1,469
CASE III—Small motor running	3,020
CASE IV—Negligible load	130
Total (365 days' operation)	8,768

COMPARISON OF LOSSES

The use of synchronous motors will improve the efficiency of the plant and consequently reduce the amount paid for power in a number of ways. These will be taken up in detail and the quantitative saving based upon 1923 operations shown.

A.—*Transformer Losses.*—Power purchased by the consumer is metered on the high-tension side of the transformers, which means that he pays for transformer losses. The poorer the power factor of the load, the larger will be the kva. taken through the transformers and the larger the copper loss. The present bank of three 250-kva. transformers give the following copper losses for the various cases of load for both types of motors:

	Induction, Kw.	Synchronous, Kw.
CASE I	10.45	6.69
CASE II	5.62	4.19
CASE III	1.61	0.69
CASE IV	....	....

These losses times the number of hours the plant ran under the several conditions will give the comparative kilowatt-hour copper loss during 1923. The iron losses of the transformers will, of course, be constant in either case and therefore have not been considered in this connection.

Losses with induction motors:

	Kw.-Hr.	
CASE I	10.45 × 4,133 = 42,100	
CASE II	5.62 × 1,469 = 8,200	
CASE III	1.61 × 3,020 = 4,900	
Iron losses	5.73 × 8,760 = 50,200	
		105,400

Losses with synchronous motors:

CASE I—A	6.69 × 4,133 = 27,600	
CASE II—A	4.19 × 1,469 = 6,200	
CASE III—A	0.69 × 3,020 = 2,100	
Iron losses	5.73 × 8,760 = 50,200	
		86,100
Saving in transformer losses with synchronous motors		19,300

B.—*Improved Motor Efficiency.*—The table giving the comparative kw. and kva. demand for the two types of motors shows that the kilowatt input for the synchronous motors will be less for the same output because of the greater efficiency. This reduction in kilowatt-hours for 1923 would have amounted to:

	Kw.-Hr
CASE I —(650 kw. — 629 kw.) × 4,133 hr=	86,793
CASE II —(500 kw. — 485 kw.) × 1,469 hr=	22,035
CASE III—(180 kw. — 174 kw.) × 3,020 hr=	18,120
Saving in kw.-hr. with improved motor efficiency	126,948

C.—*Elimination of Gear and Belt Losses.*—The larger motor is geared to a compressor through gears the efficiency of which is nearly 97 per cent, and the small motor is belted to a compressor, the belt efficiency being also nearly 97 per cent. The 3 per cent loss in each case will be eliminated by the use of direct-connected motors. This will amount to:

	Kw.-Hr
Large motor—output 472 kw. × 5,602 × 0.03	79,324
Small motor—output 935 kw. × 7,153 × 0.03	20,028
Saving in kw.-hr. by eliminating gear and belt losses	99,352

D.—*Necessity of Changing Transformers if Motors Are Not Changed.*—The present bank of three 250-kva. transformers, with a total capacity of 750 kva., is overloaded more than 23 per cent when both of the present motors, having a combined demand of 925 kva., are in operation. These transformers must be replaced with three 333-kva. transformers before next summer if the motors are not changed as further operation of the present bank at this overload is not safe. If synchronous motors are used, the demand will be reduced to 716 kva., which is well within the capacity of the present bank. The increased iron losses of the larger transformers will more than offset the reduced copper losses, adding 6,900 kw.-hr. a year to the transformer losses shown above.

In addition to the increased losses of the larger transformers, the consumer will pay 11.8 per cent interest, depreciation and maintenance on the increased value of the larger bank, which will be in the neighborhood of a thousand dollars. The increased charges will therefore amount to $118 a year more than the amount which is paid at the present time.

The consumer paid $33,547.56 for 3,762,000 kw.-hr. during 1923, or an average price of 0.89 cent per kilowatt-hour. All of the kilowatt-hour losses with the present equipment, or, conversely, the savings to be made by the use of synchronous motors, will be evaluated at this unit price. These savings, which have been shown in detail in the preceding paragraphs, amount to:

	Kw.-Hr.
A.—Transformer losses, per year	19,300
B.—Increased synchronous motor efficiency	126,948
C.—Gear and belt losses eliminated	99,352
D.—Transformer losses of larger bank	6,900
Total kw.-hr. saving	252,500
Value at 0.89 cent per kw.-hr	$2,247.25
Increased charges on larger transformers	118.00
Total annual saving to be effected with synchronous motors	$2,365.25

SAVING EFFECTED

Quotations on synchronous motors with exciter and starting equipment to replace the present induction motors give a cost of approximately $15,500 f.o.b. Fresno, Cal. The second-hand or salvage value of the present induction motors on the open market will pay for their removal and the installation of the synchronous motors, making the total outlay not more than $15,500.

It will be seen that an annual saving of $2,365.25 yields a return of 15.26 per cent on the increased investment in synchronous motors in this case. Of this the consumer will, of course, have to pay depreciation and taxes, but even so, he still has a margin left which will pay a good return on his investment. It is not probable that the maintenance in the case of the synchronous motors will be any greater than in the case of the induction motors because the gears and belt have been eliminated.

California's Million-Volt Laboratory

Method of Obtaining This High Voltage and Description of Equipment Installed at the Institute of Technology in Pasadena—Research and Experimental Needs of Southern California Are Met

By ROYAL W. SORENSEN

Professor of Electrical Engineering, California Institute of Technology, Pasadena, Cal.

THE first real high-voltage laboratory to be constructed, besides those operated by two of the large Eastern manufacturers, has just been completed at the California Institute of Technology at Pasadena. The completion of the laboratory is particularly timely because of the interest it will attract among those attending the forthcoming Pacific Coast convention of the American Institute of Electrical Engineers at Pasadena on October 13-20.

Almost five years ago—Armistice Day, 1919, to be exact—the author conceived the idea of transformer connection which, while of interest, seemed to have little practical value at the time. Less than a year later, as the result of the growing demand for higher-voltage transmission lines in southern California, combined with the lack of a really high-voltage laboratory near the Pacific Coast, a plan was developed to erect on the campus at the California Institute of Technology a laboratory which would produce a voltage sufficiently high to supply the needs of research and experimental work for many years in the future.

The goal set was 1,000,000 volts from line to ground. Setting this goal meant the overcoming of much impedance, because up to that time the maximum potential which had been developed between line and ground was just half the amount desired. One million volts between terminals had been developed by C. L. Fortescue in 1913. This was accomplished by means of two transformers, producing 500 kv. from line to ground, connected in series, with the common point grounded.

Correspondence extending over a period of several months having failed to bring forth a satisfactory plan whereby 1,000,000 volts from line to ground could be obtained, the author suggested as a possibility the cascade connection—sometimes called chain connection—which he had developed and to which allusion has been made. As a result of this suggestion, after the working out of many details, the Westinghouse Electric & Manufacturing Company agreed to build four 250-kv. units, each unit to be provided with a primary, secondary and exciting winding as needed to cascade them in such a way as to give 1,000,000 volts total between line and ground. Having decided upon this type of equipment, the Southern California Edison Company placed an order for it and erected a building on the campus of the California Institute of Technology. The first units were delivered in the fall of 1923, and after a year spent in trying various schemes of insulation between units the completed equipment has been installed. Insulation between units is obtained by means of racks made up of porcelain insulators and structural steel framework.

The electrical connections are shown diagrammatically in Fig. 1. Unit 1 receives energy from a pair of regulating transformers, each rated at 550 kva., 50 cycles, 15,000/3,000 volts. With 3,000 volts on each half of the primary of unit 1 there is induced in the secondary a potential of 247,000 volts and in the exciting winding a voltage of 3,000, making a total of 250,000 volts. The exciting winding of this unit is

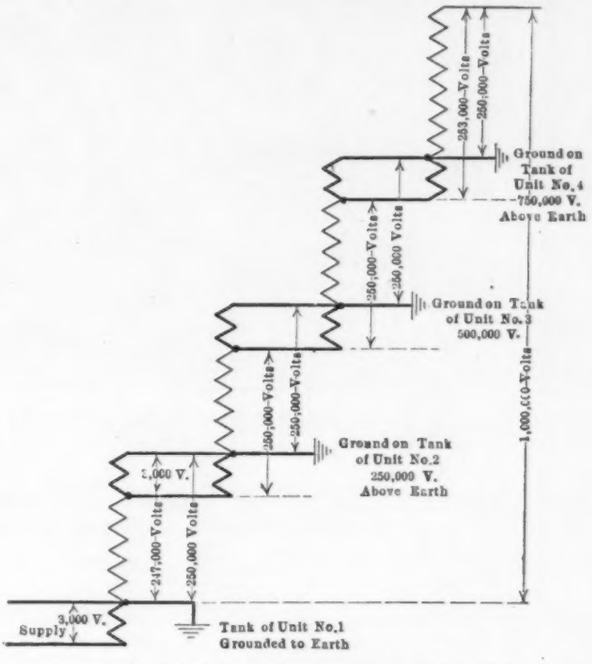

250,000 Volts
250,000 Volts
Ground on Tank of Unit No. 4 750,000 V. Above Earth
250,000 Volts
Ground on Tank of Unit No. 3 500,000 V.
250,000 Volts
250,000 Volts
1,000,000 Volts
Ground on Tank of Unit No. 2 250,000 V. Above Earth
3,000 V.
247,000 Volts
250,000 Volts
3,000 V. Supply
Tank of Unit No. 1 Grounded to Earth

FIG. 1—CASCADE TRANSFORMER CONNECTION

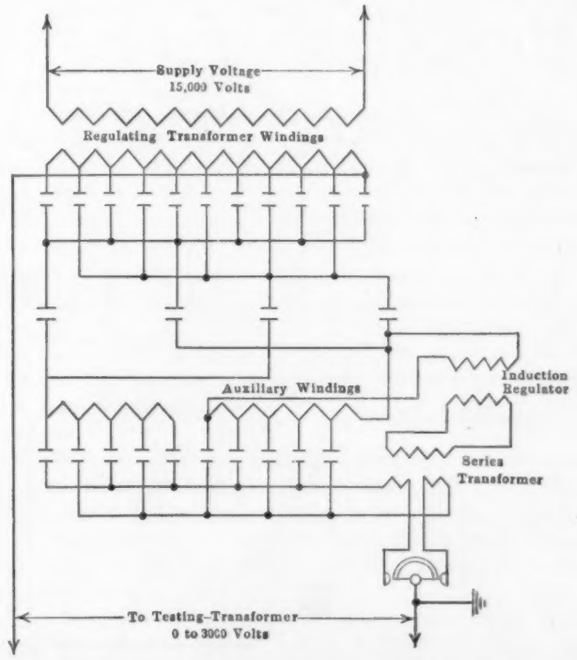


FIG. 2—CONNECTION DIAGRAM FOR REGULATING TRANSFORMERS

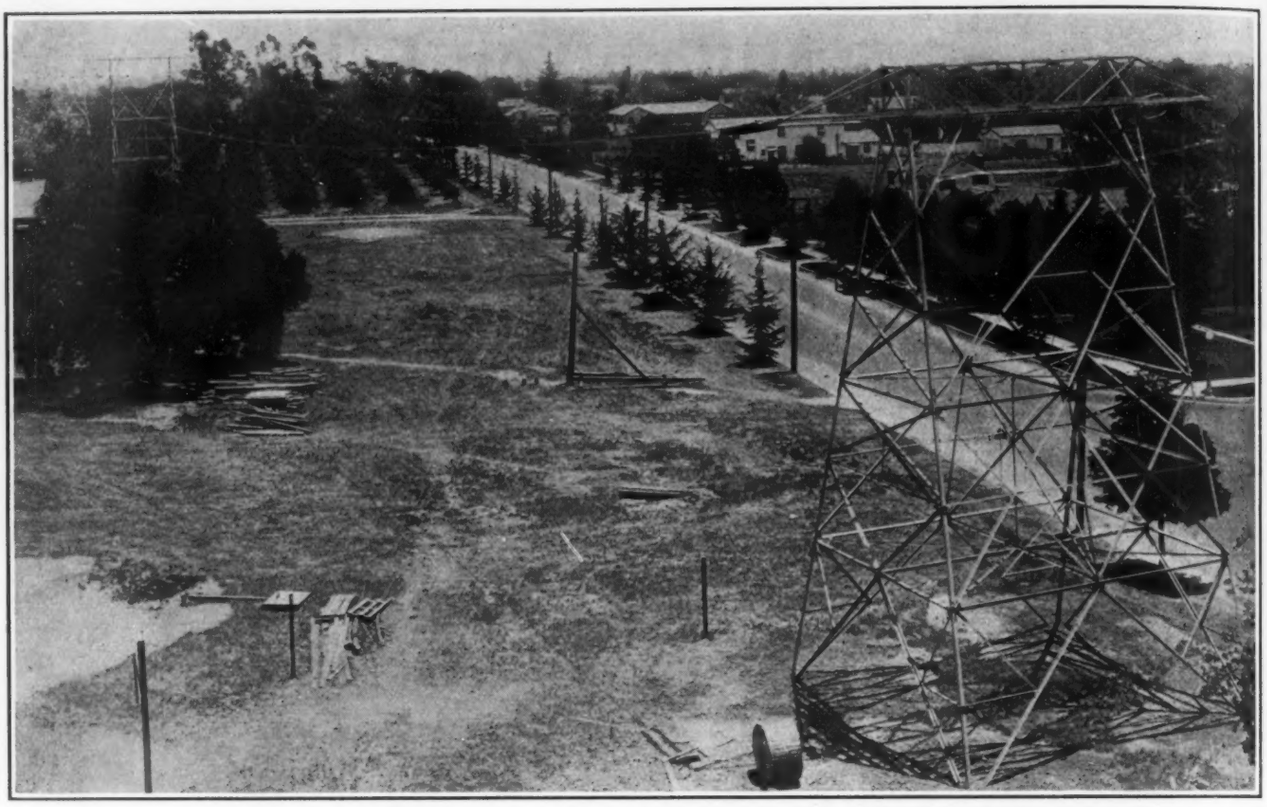


FIG. 3—EXPERIMENTAL HIGH-VOLTAGE TRANSMISSION LINE, 1,000 FT. LONG

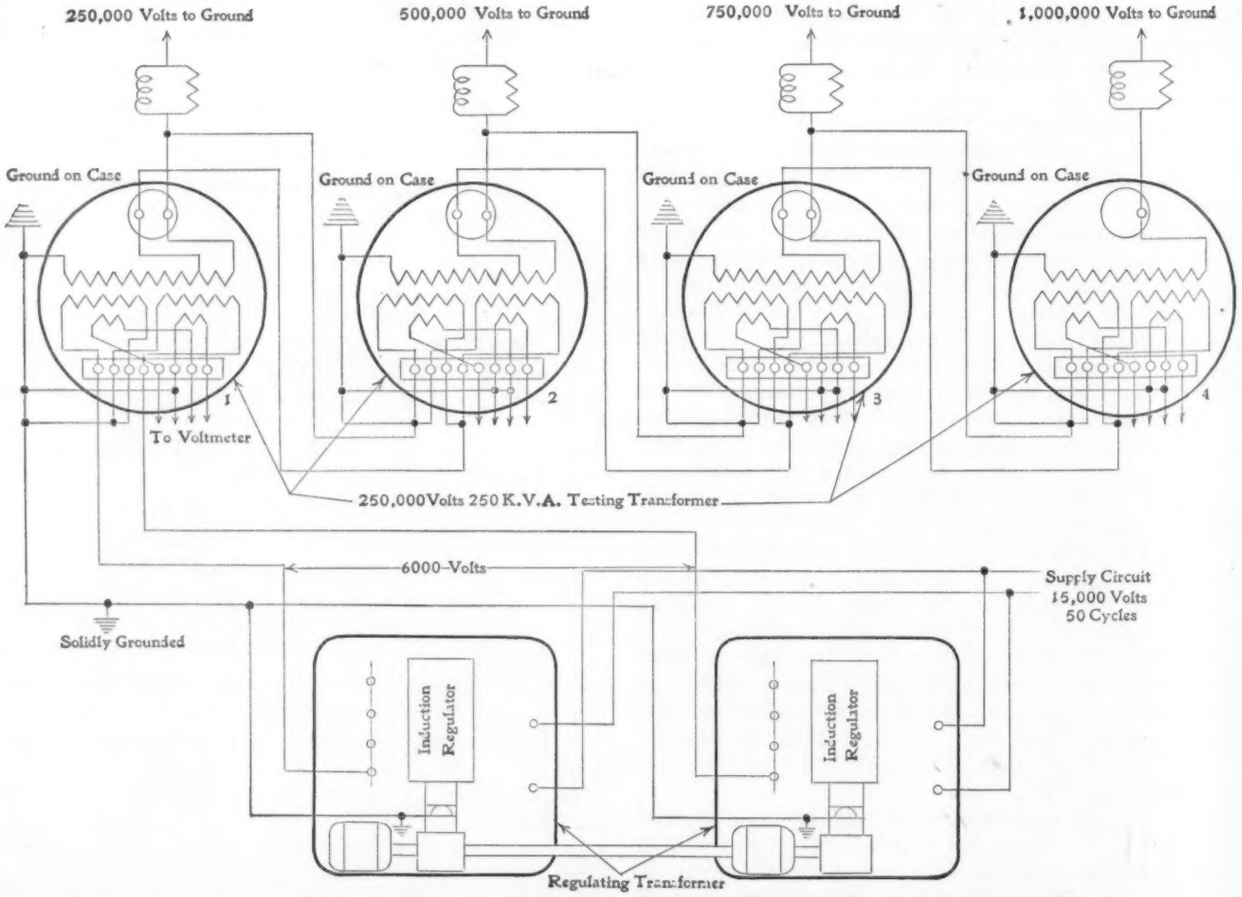


FIG. 4—DETAILED TRANSFORMER CONNECTION, INCLUDING REGULATING TRANSFORMERS

connected in series with its secondary and is also connected to the primary of unit 2, which is a duplicate of unit 1 but has its primary windings connected in parallel. By this means unit 2 is connected in such a way as to add its voltage to that of unit 1, and so on through units 3 and 4, there being 1,000,000 volts from the terminal of unit 4 to ground. A more complete diagram of connections is shown in Fig. 4, including the two regulating transformers. Each unit weighs 45,000 lb. and contains 2,950 gal. of oil.

The regulating transformers shown in Fig. 4 receive energy at 15,000 volts and deliver it to unit 1 at potentials varying from zero to 3,000 volts on the secondary of each regulator. The common point of connection between regulator secondaries is grounded; hence the primaries of unit 1, in series, have a maximum potential of 6,000 volts across the entire winding of the transformer, with 3,000 volts from terminal to ground on each half and on each regulator.

The regulators and switches are controlled from two switchboards, one on the lower observation gallery and one on the main floor. Either board may be used, or the transformers may be separated and one board used for each part of the equipment.

The switches in the regulating transformers are operated by a direct-current motor equipped with an armature rheostat for speed control. Combined with the switches is a small induction regulator which works in conjunction with them to give absolutely a smooth change in voltage without any evidence of irregularities. The connections for the regulator transformers are shown in Fig. 2.

The problem of measuring the voltage of this equipment is a difficult one. At present the total voltage is measured only by a 100-cm. sphere-gap voltmeter. For checking, the voltage of each unit can be approximately determined by means of the voltmeter coils, and as a further check a crest voltmeter is provided which may be used in connection with the condenser bushing of any unit whose tank is kept at ground potential.

Not the least of the desirable features of the cascade connection is the possibility of having two two-unit equipments good for 500,000 volts with two units in cascade, or of connecting the high-voltage windings of these units in star, thus obtaining 433,000 volts, three-phase. Many other combinations may be obtained. Examples are the combination which would give 1,000,000 volts between terminals, center-grounded, and the 500,000-volt step-up-step-down, single-phase system with one end or the center grounded as desired.

What the World Power Conference Showed About

Modern Steam Turbines and Their Design

Four Authoritative Papers on High Pressure Show the General Lines of Development in Great Britain, Holland, Sweden and the United States—Problems in Dispute Cleared Up in Discussion

A COMPREHENSIVE study of the turbine papers presented at the steam utilization session of the World Power Conference recently held in London brings out some very valuable data relative to what has been accomplished in the field of higher steam pressures. Present-day steam turbines demand the best of material, skill in avoiding nodes, etc., and the finest of work and design. Any turbine must conform to the requirement of reliability in service. Power has become such an intricate part of daily life that in its use dependability is second only to efficiency. Units are built in capacities of 30,000 kw., 50,000 kw., 60,000 kw. and may possibly reach 100,000 kw., and the demand for equipment is so great that it is not unusual for orders to be placed for three or four such units at a time.

Sir Charles A. Parsons in his paper traced the rise and development of the steam turbine. He showed that in modern turbine design there arises the fundamental question of high steam velocities versus moderate or low steam velocities. From the point of view of reduction of the number of stages, and therefore the over-all length of the turbine for a given capacity, it is clear that high steam velocities are desirable, but in proportion as the steam velocity is increased the essential benefit of pressure compounding is sacrificed, for the advantage of that principle does not rest solely on the fact that the hydraulic head under which each simple turbine of the series works is reduced, but also on the evidence that the efficiency of conversion of the available energy of the steam into mechanical work in the nozzles and blading increases as the velocity is decreased. Recent researches in the laboratory, with fixed nozzles, built without blade rings, have confirmed the view that nozzle efficiency diminishes with increasing steam velocity, and it remains to find out the causes of this loss of efficiency and whether it may be possible to reduce or eliminate it.

With regard to the design of blading of the impulse type, Sir Charles said there are two schools of thought. One of these favors the proportioning of the passages so as to obtain as far as possible what is known as "free deviation"—in which the blades are arranged so as simply to deflect the steam jets issuing from the nozzles without alteration of the steam pressure. The other favors the employment of a certain amount of pressure drop in the revolving-blade passages. The latter procedure is conducive to higher stage efficiency, but involves some leakage radially over the shrouding, and also circumferentially in the case of partial admission.

Advance in the direction of increasing the thermodynamic value of the heat in the steam without unduly increasing the maximum temperature is, Sir Charles said, being made by increasing the mean temperature of heat reception. He described four methods by which this may be accomplished.

The first method is the adoption of regenerative feedwater heating, by using steam tapped off from successive stages of the turbine. The necessity to heat

TABLE I—OVER-ALL THERMAL EFFICIENCIES WHICH IT IS ESTIMATED COULD BE REALIZED WITH INCREASED BOILER PRESSURES (SIR CHARLES PARSONS'S PAPER)

Stop-Valve Pressure, Lb. Gage	Stop-Valve Temperature, Deg. F.	Initial Superheat, Deg. F.	Assumed Reheat Pressure Lb. Abs.	Reheat Temp., Deg. F.	Restored Superheat, Deg. F.	Exhaust Vacuum. In. Hg. Bar. 3.0 In.	Stage Feed-Water Heating from 65 Deg. F. Up to (Deg. F.)	Thermal Efficiency (from Steam to Electricity)	Assumed Boiler-Plant Efficiency (Including All Auxilaries)	Over-All Thermal Efficiency (from Coal to Electricity)	Per Cent Gain
250	750	344	65	700	4.2	29.25	360	31.6	84.0	26.52	.....
500	750	281	10	700	372	29.25	420	33.5	83.5	27.97	5.45
1,000	750	204	15	700	343	29.25	510	35.2	83.0	29.20	10.08
1,500	750	153	25	700	299	29.25	550	36.6	82.5	30.20	13.82
2,000	750	114	40	700	254.5	29.25	600	37.5	82.0	30.75	15.90

(Feed-water heated to within about 50 deg. of boiler temperature by means of steam withdrawn from turbine blading at several points. Boilers equipped with economizers or air pre-heaters, or both, so as to recover heat from the flue gases and maintain high thermal efficiency. Generator efficiency taken as 96.5 per cent at full rated output.)

the feed-water—that is, to reheat the water of condensation—is the defect of the Clausius cycle. If, however, a perfectly regenerative process could be employed for heating the feed, the efficiency of the Clausius cycle for saturated steam would be brought up to that of the Carnot cycle. As a compromise, feed-water heating by steam extraction from a few stages of the turbine, in conjunction with economizers, is generally accepted practice in modern power stations, but there is a tendency to develop this system further so as to attain higher feed water temperature by the steam heating. This makes it necessary that some method be used to absorb the residual heat in the flue gases.

As a second method of increasing the mean temperature of heat reception, an advance might be made if after superheating to the maximum temperature further heat were added so as to maintain isothermal expansion throughout the initial stages of the turbine. This could profitably be carried only to such a point that subsequently adiabatic expansion in the turbine to the condenser vacuum would leave the steam jet saturated.

A third method is to increase the mean temperature of the heat reception by increasing the boiler pressure. With a boiler pressure of 250 lb. per square inch, a final temperature of 750 deg. F. after superheating and a feed-water temperature of 79 deg. F., the mean temperature of heat reception is about 360 deg. F. But if the boiler pressure is increased to, say, 2,000 lb. per square inch, still superheating to 750 deg. F., then, since the latent heat is received at the increased temperature of the boiler, the mean temperature is considerably increased, namely, to 480 deg. F. If, in addition, it be assumed that the water is fed into the boiler at the boiling temperature by means of feed heaters in cascade in each case instead of at 79 deg. F., the main temperatures of heat reception are increased in the one case to 430 deg. F., and in the other to 680 deg. F.

The design of exhaust advocated by Baumañ is the fourth method. In this, instead of carrying over a part of the steam by special ports to additional blade rings, it is made to flow through inner annuli of the preceding blade rings, the vanes of these being specially shaped to reduce the resistance involved to a minimum.

An application of these principles, Sir Charles continued, is made in the turbine plant of 50,000 kw., normal capacity, to be erected in the new Crawford Avenue power station, Chicago, which when the conference was held was nearing completion at Newcastle-on-Tyne. In this plant there are three cylinders in series on the steam flow, each driving an alternator, the three alternators being electrically coupled in parallel. This section of Sir Charles' report, outside of the purely mechanical design details, has already been published. (See ELECTRICAL WORLD for August 16, 1924, page 330.)

TABLE II—SAVING IN FUEL CONSUMPTION WITH HIGH PRESSURES

(Saving in per cent at 750 lb. and 1,500 lb. steam pressure in comparison with 300 lb. pressure and 350 deg. C. steam pressure)

Exhaust Conditions	96 per Cent Vacuum		15-Lb. Back Pressure (Gage)		45-Lb. Back Pressure (Gage)	
Admission pressure, lb....	750	1,500	750	1,500	750	1,500
350 deg. C. steam temp...	7.5	9.0	9.0	11.0	9.0	11.5
400 deg. C. steam temp...	10.0	11.5	10.5	13.0	10.5	13.0
500 deg. C. steam temp...	15.0	16.5	15.0	16.5	14.5	16.5

TABLE III—SAVING IN FUEL CONSUMPTION FOR POWER PURPOSES

(Saving in per cent at 750 lb. and 1,500 lb. steam pressures in comparison with 300 lb. pressure and 350 deg. C. steam temperature.)

Exhaust Conditions	96 per Cent Vacuum		15-Lb. Back Pressure (Gage)		45 Lb. Back Pressure Gage)	
Admission pressure, lb....	750	1,500	750	1,500	750	1,500
350 deg. C. steam temp...	7.5	9.0	40	45	46	51
400 deg. C. steam temp...	10.0	11.5	44	48	49	53
500 deg. C. steam temp...	15.0	16.5	51	53	55	57

SWEDISH TURBINE PRACTICE

The turbine practice of the De Laval Works in Stockholm, Sweden, was described in a paper by V. Nordstrom. The correct speed for a turbine wheel, from the point of view of fluid friction losses, should increase about as the square root of the pressure. That is, if 3,000 r.p.m. were suitable for 150 lb., 9,500 would give the same loss at 1,500 lb. This is for the same heat drop per stage; higher heat drops per stage at the higher pressures naturally require still higher speeds. The solution of this difficulty is to connect high-pressure and low-pressure turbines by spur gearing which has an efficiency of 98 per cent and up. When properly made, the reliability of gear drive is beyond dispute. The small size of high-pressure turbines makes it a simple matter to handle fairly high temperatures.

Very high steam pressures may find employment in back-pressure turbines, where the economy of this arrangements is quite obvious. It will be found that the gain in actual fuel saving under certain circumstances can be quite as large for a condensing plant as for an extraction turbine or for a combination of a back-pressure and condensing turbine.

In Tables II and III the fuel saving has been given on the basis of different assumptions as regards steam temperature at higher steam pressures. The figure adopted for comparisons is 300-lb. pressure and 350 deg. C. steam temperature. It has been assumed in case of extraction turbines that the gain in power due to the higher pressure is exactly sufficient to make the condensing section superfluous. The gain for this type

of turbine, therefore, is expressed in maximum figures. Proper consideration has been given to a certain loss of efficiency in the turbine as a result of the higher admission pressure. The greater work entailed on the feed pumps, on the other hand, has not been estimated, which in most of the cited cases makes figures for the saving slightly too large.

If the saving is determined in percentage of the fuel consumption for energy production, the result will be economy to the extent shown in Table III. It should, however, be borne in mind that these figures refer to a smaller amount of fuel than the corresponding figures in Table II and that the product of the amounts and the percentage gain are in both cases equal.

The paper "Steam Turbines for High Pressure," by C. F. Stork, was presented by J. Strumphler, Gebr, Stork & Company, who told why the Stork company adopted the Erste-Brünner machine instead of the Zoelly machine that it had been building. Extremely good efficiencies had been obtained in Stodola's test of the turbine at the Nestomitz sugar mill (about 83 per cent Rankine efficiency). The trials have shown that a high "quality figure" is needed for the high-pressure part and that it is by no means immaterial in what way this is reached; in other words, that it is one thing to use the heat drop in one large wheel, or in a few large wheels, with high circumferential speeds, and another to use the same heat drop in a greater number of small wheels with low circumferential speeds. It proved to be the first essential point that the wheels should obtain steam around the whole periphery.

Effect of Shocks in Turbines

More than fifty steam-flow trials have shown that transition of the steam to a different diameter will cause surging shocks even at velocities far below the velocity of sound. These surging shocks at the same velocities are more violent as the steam becomes greater in density, as the radius of curvature of the steam course is smaller and as the transitions between the different diameters occur less gradually.

It was also maintained in the paper that there is no necessity for lower efficiencies in the high-pressure section of a turbine. Governing by cutting out nozzles does not lead to good economy at partial load. Low steam velocities in the high-pressure section are essential. A 16,000-kw. turbine that is now under construction has a guaranteed steam consumption of 8.44 lb. per kilowatt-hour, using steam at 500 lb. and 750 deg. F.

American Tendencies

The tendencies of American practice with regard to steam turbines and condensers were dealt with in a paper by Francis Hodgkinson, Westinghouse Electric & Manufacturing Company. This paper should long be referred to as a comprehensive and authoritative treatise on the design of large turbines and condensers. Its author first showed how the difficulties of providing an adequate area for the passage of the steam through the low-pressure end of the turbine have been surmounted by different designers and firms. Double-flow on multiple steam paths, in the low-pressure end, and compounding the turbine by using two or more separate cylinders, frequently driving generators at different speeds, have been successfully adopted. The Baumann multiple exhaust of the Metropolitan-Vickers Company is another promising design. The first Westinghouse 30,000-kw. cross-compound machine, built for the Interborough Rapid Transit Company in 1914, with its two independent rotors running at 1,500 r.p.m. and 750 r.p.m. respectively, was followed by a 40,000-kw. unit of somewhat similar design, at 1,800 r.p.m. and 1,200 r.p.m., for the Narragansett Light & Power Company, and a 60,000-kw. three-cylinder unit for the Colfax station of the Duquesne Company. With the three parts all in normal operation, this set will develop 50,000 kw. with a steam consumption of 10.93 lb. per kilowatt-hour. With one of the low-pressure cylinders cut out, it will develop 36,000 kw. for 12.5 lb. per kilowatt-hour, and with the two low-pressure cylinders alone running on high-pressure steam, 50,000 kw. can be produced for 13.5 lb. per kilowatt-hour. The steam pressure is 265 lb., the superheat 175 deg. F. and the vacuum 28½ in.

For some 50,000-kw. turbines now under construction the Westinghouse company is using two-cylinder cross-compound machines with multiple exhaust blading. Mr. Hodgkinson highly commended the design of the 50,000-kw. set which the Parsons company is building for the Crawford Avenue station in Chicago. It is thought likely that turbines of 50,000 kw. and over and all large machines for steam pressures higher than 400 lb. per square inch will be constructed in future on the compound principle, although the General Electric Company has built very successful machines to develop 50,000 kw. at 1,200 r.p.m. in a single cylinder.

Design of Modern Unit

A modern Westinghouse turbine to develop 35,000 kw. at 1,800 r.p.m. has multiple exhaust blading. The blades are of warped surface and of tapering section, so that the maximum stresses due to centrifugal force do not exceed 20,000 lb. at an overspeed of 20 per cent. The drum stresses under similar conditions do not exceed 18,000 lb. The steam is first expanded in nozzles from its initial pressure down to a pressure of about 120 lb. absolute. It then acts on an impulse element, having two running rows of blades with a mean velocity of 463 ft. per second. The impulse blades are 2½ in., 2 in. and 1½ in. wide respectively for the three rows. The reaction blading is arranged on a conical surface, to avoid eddies. A gain of efficiency of 2½ per cent is attributable to this feature. To make the turbine adaptable to extreme conditions of regenerative feed heating, four outlets are provided from which steam may be bled off at pressures of 3½ lb., 16 lb., 50 lb. and 120 lb. absolute.

Mr. Hodgkinson also dealt with blade design and materials, balancing, labyrinth packings, bearings and thrust blocks, and he concluded with a section on condensing-plant equipment.

Prominent Engineers Discuss Subject

This session on steam utilization brought together from both sides of the Atlantic many prominent and outstanding engineers in the power-station and turbine field. Probably so representative or authoritative a gathering had never before assembled, and a weighty and useful discussion was provoked.

The most recent type of turbine, built by the General Electric Company, was described by O. Junggren of this company. It has single wheels throughout, with the characteristic of a conical construction of rotor that gives a full admission and an uninterrupted path for the steam, thus producing a simple and efficient turbine and providing a unit of large capacity of very simple construction. The development of the turbine has now reached a point where no great advancement

in efficiency can be expected. The most promising field is to be found in an increase of temperature and pressure in conjunction with bleeding for heating the feed water and reheating the steam after it has done a certain percentage of the total work.

EXPERIENCE WITH REGENERATION TURBINES

S. Z. de Ferranti reviewed his experience in turbine design and construction. In 1910 he built a 3,000-kw. turbine running at 3,000 r.p.m. that was provided with a regenerator between the exhaust and condenser and was later fitted with an arrangement for bleeding in four stages. The blading was of the Parsons system and there was no dummy. Its performance was generally satisfactory. However, Mr. de Ferranti abandoned his work when a turbine was placed on the market which, from the standpoint of economy, was a great advance on anything achieved up to that time. Four years ago he returned to the idea of doing work at high temperature, built a turbine with a 10-in. wheel and ran it at a temperature of 900 deg. C.

Sir Charles A. Parsons said that in his opinion the reason why Mr. de Ferranti's idea would not prevail was the disposition of cast iron to grow and change shape at such temperatures.

J. P. Chittenden, English Electric Company, indorsed the view that, when extra high pressure is used, not only should the high-pressure end of the turbine be entirely distinct from the low-pressure end, but its speed of rotation should be considerably higher if leakage and windage losses are to be kept down and a good arc of admission obtained. At Rugby the English Electric Company has built a 1,000-kw. turbine to work with a pressure of 1,500 lb. per square inch and a speed of 25,000 r.p.m. has been chosen for the high-pressure end. This is to work in conjunction with the Benson 3,200-lb. boiler which has been satisfactorily tested, and the whole combination appears to offer possibilities which should not be disregarded by those interested in advanced power-station practice. Mr. Chittenden also advocated the "straddle" type of blading, as used by some makers, as the strongest and lightest method of fixing impulse blades.

ADVANTAGES OF MULTIPLE-EXHAUST SYSTEM

Speaking on the advantages of the multiple-exhaust system, K. Baumann, Metropolitan-Vickers, referred to recent tests of a 7,000-kw., 3,000-r.p.m. machine at Bristol, carried out with the view of finding the exact value of the system. The two stages embodying the multiple exhaust were removed and careful tests made under conditions of constant load and vacuum. The parts were then replaced and the tests repeated with the same quantity of steam passing through. When working with a 28.6-in. vacuum, the efficiency was lowered 6 per cent by the removal of the multiple exhaust. The effect of the multiple exhaust was equivalent to increasing the vacuum from 27.8 in. to 28.6 in.

According to recent researches of the British Electrical and Allied Manufacturers' Association and the Institute of Mechanical Engineers, reported by B. Pokobradsky, Fraser & Chambers, Inc., nozzle efficiency is a maximum at a steam speed of about 300 ft. per second, and after falling off beyond that speed rises to a second maximum at about 1,500 ft. per second. This indicates that a high-pressure turbine should have many stages of small diameter and that a low-pressure turbine should have a large diameter. The joint of an extra-high-pressure casing is troublesome, and the speaker advocated a double casing for the high-pressure turbine, the parts being coaxial with a steam jacket at medium pressure between. This relieves the pressure on the joints.

The decrease in efficiency which takes place with higher steam temperature was discussed by M. Konig, English Electric Company, who said that the most economical temperature is that at which the steam is just superheated at the exhaust. The expansion line of the steam should run parallel to the saturation line, and if the steam could be continuously reheated this might be possible, but the idea did not appear practicable. Turbines are defective in respect to the "quality figure" referred to in Mr. Stork's paper so far as the low-pressure part is concerned.

EFFECT OF NUMBER OF STAGES ON EFFICIENCY

That the number of stages in a turbine has little to do with the efficiency was the expressed opinion of George A. Orrok. There are turbines with eight stages that are very efficient and turbines with eighty stages that are just about as efficient, he said, and between the two limits is a wide sweep of relative efficiencies running about the same. Variations in the design cut no figure in the guarantees. What the central-station man wants is a turbine that will run 8,760 hours in the year, that can be started up from "cold" in two minutes and the blades of which will not deteriorate.

S. J. Watson, speaking for the turbine users, said that an important consideration was cost. With more casing to a machine one can get an improvement in economy; but how much does it cost? Which is the better, he asked, two 20,000-kw. machines, each with its own casing, or one 50,000-kw. machine consisting of three or four casings? It must be borne in mind that the best machine of today is not going to occupy that position in three or five years' time, and it is necessary to obtain during a comparatively short period of service a saving which bears some relation to the additional capital cost.

The 1,200-lb. installation being put in at Weymouth, Mass., was described by I. E. Moultrop, Boston Edison Company. A very efficient installation may be less economical than something simpler. A 530-lb. reheating design does not fit the conditions of this company, where the night and Sunday load is very light, but a simple station with a high-pressure unit superimposed does. One gets no extra capacity for the money spent for greater efficiency, but by superimposing a high-pressure unit he gets increased efficiency and capacity too, and the unit cost will be about the same. Bernard Price, Victoria Falls Power Company, South Africa, considered efficiency from the point of view of fuel cost. The cost of maintenance, too, may be no small factor and is very important when the plant is installed far from the maker of the equipment.

The replies of the authors to the points raised in the discussion were brief. Mr. Cook, replying on behalf of Sir Charles A. Parsons, did not consider that Mr. Pokobradsky's double casing was yet necessary. With regard to the advantages of efficient turbines, it should be pointed out, he said, that, although the turbine itself may cost more, the boiler plant is smaller and cheaper and coal and ash-handling equipment is all reduced. Mr. Hodgkinson said that one of the most valuable features of double-cylinder machines is the possibility of running the two rotors at different speeds, thus permitting a small diameter for the high-pressure rotor and a large diameter for the low-pressure rotor.

Problems of the Industry That Come with Growth*

Employee and Customer Relations—Interrelation of Plant Cost, Depreciation and Load Factor—Stock Ownership and Senior Securities—Engineering Problems Again to the Fore

By JOHN F. GILCHRIST
President Association of Edison Illuminating Companies

IN THE growth and development of our industry the association year 1923-1924 has not been very different from the three or four years which preceded it. It has been characterized by very large increases in business, heavy financing, increasing appreciation of the practicability of central supplies of power for all requirements, and evidences of every kind that our business is becoming all that was hoped for it a quarter of a century ago by its most far-sighted and optimistic supporters. In 1922 we found invested in our business more than ten times as much money as had been invested up to 1902. The gross revenue has increased more than ten times and the kilowatt-hours generated more than eighteen times in the same two decades, and rough estimates of the intervening two years indicate that there has during that time been no diminution of the rate of expansion.

Perhaps one of the most important of the questions that confront us is one which arises as organizations become larger and older. The machine is getting pretty big and pretty complicated. It is difficult at times to keep it tightened up to just the degree that avoids unnecessary friction on the one hand and lost motion on the other hand. We have reached a point where it is quite impossible for any one to know the names and faces of more than a small percentage of our company employees. This is a most important subject. In ours, as in every business, the human factor is the overshadowing one. We are prone to accept it as fundamental and pass over and give our time to the details. As our problems get bigger, our institutions and undertakings bigger, are our men and women also coming on in their growth, education, interests and training at the same rate? Is our business, because of the great size of organizations, beginning to suffer because of a deficiency in the channels through which the wishes and ideas as well as the orders of the executive should pass down to the organization for action? Have we made proper provision and opportunity for that real acquaintanceship among executives, department heads and employees which breeds respect, confidence and knowledge of ability, and which, by creating interest in and inspiring an organization, becames such a factor in success?

A growing percentage of women to total employees is a feature of present-day development, and the percentage of women figured on the basis of total employees coming in contact with the customers is still larger. This situation has resulted in many of the companies which are most advanced in personnel matters providing special opportunities for women to develop in their knowledge of the company's policies, business, financial structures and similar matters which all employees anxious to get ahead should be familiar with.

All of this discussion brings me to another subject of great interest—one to which a great deal of attention is being paid at the present time—public relations.

We all believe in plans for the cultivation of the pleasantest relations with our customers and the people with whom we live and deal. A great deal of work is being done to promote such a relationship—some of it most practical and effective. Here again our greatest obstacle is the size of our organizations—the physical difficulty of knowing our customers, of knowing their points of view.

Cost of Plant and Load Factor

And now let us turn to the consideration of a problem of quite a different kind. I wish to direct your attention to our present cost of plant, and I raise the question whether this has become a matter of serious concern. During the latter years of the war, when prices were rising rapidly and we found plant cost double what it had been in the early years of the last decade, it did not give us any great concern, because, apparently, our conclusion was that the budgets of a year or two at a higher rate would not have very great influence in increasing the average cost per kilowatt of our total investment. But, as the years have rolled by, with no evidence of a substantial reduction, and as the tremendous growth of the business has required more extensive construction programs, we find ourselves with 60 to 80 per cent of our total capacity having been installed during the years of high prices, so that, contrary to our thought of six to eight years ago, our total average cost of plant per kilowatt is very little below the present-day cost.

What we can do about it is not clear, but, with the prospect of gradually decreasing prices, the chance of our finding ourselves with a plant which has cost us much more than the reproduction cost of some future date gives us some reason for apprehension. This possibility causes us to give consideration to the necessity of establishing more than ordinary reserves, properly approved by the regulating bodies. Consideration of this high-priced investment would seem to urge a more intensive consideration of the problem of securing for it a better return, as, for instance, by the improvement of load factor, so that this expensive investment may be useful and earning more than 50 or 60 per cent of the time, as is the case with the average company today.

What machinery has done for man in the factory.

*Abstract of address made at the annual convention of the Association of Edison Illuminating Companies, New London, Conn., September 8, 1924.

the office and the field, machinery will do for woman in the home, but it must of necessity be electrically operated machinery. I commend to your attention a close study of the problems incident to the complete "powerization" of the homes of the people and to the removal of the commercial barriers which today are interfering with a natural and smooth flowing distribution of universally desirable electrical labor-saving devices.

STOCK OWNERSHIP AND SENIOR SECURITIES

Turning to another interesting development of the industry, I ask you to consider the wide distribution of the securities of public utility companies among the people, commonly referred to as customer ownership, particularly certain phases of it which may or may not have had your attention. The manner in which junior securities of our companies have been taken up by the purchasers of small blocks of stock has been a great surprise to most of us and has indicated in an astonishing way the very large volume of funds for investment which exist in the hands of the masses of our people at the present time. We realize that a new condition is here, and that as a result of this fact the leaders in industry have a new responsibility thrust upon them—that of doing their share in providing safe and proper investment for the accumulated wealth of the people.

While on this subject, I ask you to note the growing stability of the junior isues and the desirability of changing the laws, where necessary, to permit banking and insurance institutions in all the states to enlarge their zones of permitted investments; and, again, I wish to direct your attention to the consideration of the proper proportions of senior and junior securities in the financial structures of our companies. From some points of view there is much to be said in favor of diminishing the percentage of the "dead hands" of our senior issues in favor of the partnership form of ownership, devoid of assured rate of return as represented by stock ownership. The disadvantage lies in the difference between the higher rate of return to which the stockholder is entitled and the lower interest of the senior security. This difference, when the greater investment per dollar of income under present-day costs is taken into consideration, represents a decided difference in the load to be carried by the corporation.

Because we turn our capital so slowly in the utility business, interest charges are magnified and become of very much more importance than in the case of businesses which turn their capital three or four times per year. On a basis of five-year turnover, every 1 per cent of added interest charge becomes a 5-cent charge against each dollar of annual income. In other words, the portion of the dollar of income chargeable to interest in a company where the average cost of money is 6½ per cent is 33 cents.

Therefore, it behooves us to study well the question of interest and endeavor at all times to increase the stability of our properties and the attractiveness of our securities to our investing friends so that they may want them at low rates of interest. When conditions are such that it is necessary to pay higher rates of interest temporarily, thought should be given to securing provisions permitting refinancing, so that when the cost of money is again low it may be possible to shift again to securities carrying a lower interest charge.

Twenty years ago and prior thereto much of the discussion at the meetings of this association dealt with the development of apparatus, systems and construction work. The engineering and development side of the business was pre-eminent, as was natural in the early stages. Then came a long period in which these subjects were less prominent, and it was evident that it was the political, commercial and public-relations questions of the industry which were commanding the most attention. This is still the case, perhaps, but there are indications that the tremendous extensions of the business has pushed it to a point where it has in some directions caught up with and passed the engineering side and is rather waiting for the latter.

Co-operative study of manufacturers and utilities has resulted, among other things, in a continuing series of improvements in the lamp and the turbo-generator. In the present period of heavy loads, high voltages and long transmissions, experience is indicating that high-tension cables, switches and some of the other auxiliary apparatus are quite inadequate and are not capable of doing their parts in maintaining the kind of service which should be the rule in our business. It is obvious that concentrated attention should be put immediately on the engineering problems which are thus presenting themselves.

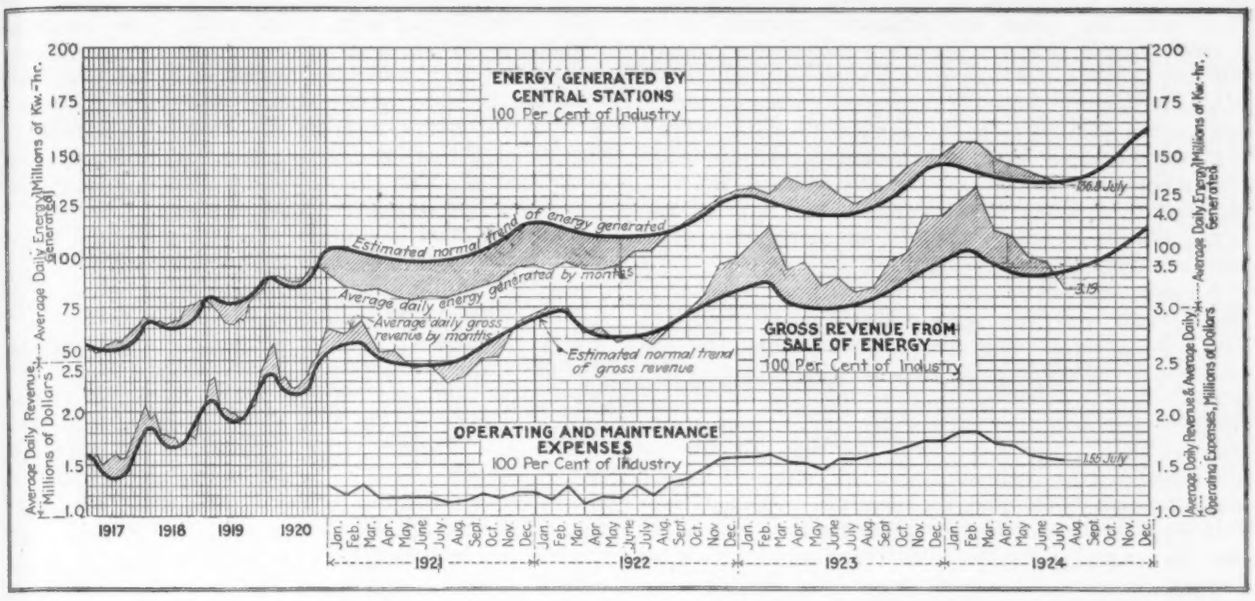
The advantages of interconnection of systems, or superpower, as it is popularly known, afford the great interest of the hour. Somewhat superficial consideration seems to indicate, as in the better known fields of our businesses, the importance of the public-relations side of this subject. A most important consideration is the necessity for more general information and a more practical understanding of the present situation. It is reasonable to expect that the legal and commercial sides of the subject, as well as construction and operation, will present their problems as we bring our systems together.

IMPROVEMENT IN COAL PRODUCTION

In our consideration of the future of the power utility, we rarely give much thought to the production and transportation of coal. Here is a commodity the delivered cost of which is a most important item and one which becomes increasingly so as improvement of load factor makes it a larger part in proportion of the cost of the kilowatt-hour. Those who should know most about it advise us that the possibilities of improvements in mining methods are very great, and by the development of improved machinery to supplant hand labor in mining there is no question that production costs could be materially lowered. Moreover, in the matters of arranging a better annual load factor, of coal production and transportation of coal in solid trains, of more and larger cars directly from mine to power house, intensive study may yield reward in the future.

No discussion of the future of our industry would be complete which did not give a place of some prominence to the subject of service to the rural districts and the farms. Here is a very large part of our population, a source of great national wealth, which, as yet, has profited from the great advantages of electrical service very slightly, notwithstanding the fact that it is hard to conceive of a more laborious life or one where the auxiliary of a flexible and practical source of power would be a greater boon. The problem of furnishing service in this field is very great, but it is a problem of our industry and must be met. There is little question that the results would justify the cost of the service, although that cost naturally must be much higher than where it is rendered in more thickly populated communities.

July Revenue 26 per Cent Under Year's Peak


ENERGY GENERATED BY CENTRAL STATIONS
100 Per Cent of Industry
Estimated normal trend of energy generated
Average daily energy generated by months
86.8 July
GROSS REVENUE FROM SALE OF ENERGY
100 Per Cent of Industry
Average daily gross revenue by months
Estimated normal trend of gross revenue
OPERATING AND MAINTENANCE EXPENSES
100 Per Cent of Industry
1.55 July
Average Daily Revenue, Millions of Dollars
Average Daily Energy, Millions of Kw.-Hr. Generated
Operating Expenses, Millions of Dollars
1917 1918 1919 1920 1921 1922 1923 1924

ACTIVITY during July as reported by the central-station industry was slightly below the ELECTRICAL WORLD'S estimated point of normal activity for that month, the figure arrived at for energy generated being 1.1 per cent below normal. This is the first time since August, 1922, that the ELECTRICAL WORLD'S estimated point of normal activity for a given month has not been exceeded. The total sales of energy have shown a gradual reduction since February, which decrease has each month exceeded that which would have normally been expected during this season of the year because of seasonal lighting requirements. Up to and through June, however, the central-station branch of the electrical industry operated above the estimated normal, but with July the central stations joined the

TABLE III — OPERATIONS OF CENTRAL-STATION HYDRO AND FUEL POWER PLANTS IN THE UNITED STATES
(100 per Cent of the Industry)

Month	Energy Generated				Fuel Consumption		
	Hydro Plants		Fuel Power Plants				
	Thousands of Kw.-Hr.	Per Cent	Thousands of Kw.-Hr.	Per Cent	Coal (Short Tons)	Oil (Barrels)	Gas (Thousands of Cubic Feet)
1924							
*May	1,911,563	43.3	2,501,544	56.7	2,409,707	1,163,023	2,908,367
*June	1,670,862	39.8	2,522,837	60.2	2,307,156	1,299,497	4,176,731
*July	1,591,595	37.5	2,650,176	62.5	2,392,726	1,349,838	4,924,990

*As collected by United States Geological Survey. The data are for the electric light and power industry only.

TABLE I—GENERATION AND DISTRIBUTION OF CENTRAL-STATION ENERGY IN THE UNITED STATES
(100 per Cent of the Industry)

Month	Kw.-Hr. Generated Monthly			Distribution of Energy Generated										Kw.-Hr. Purchased for Resale	
				Total Energy Consumption by Central-Station Customers, Kw.-Hr.		Energy Consumed for Lighting Kw.-Hr.		Energy Consumed for Power Kw.-Hr.		Energy Sold to Electric Railways Kw.-Hr.		Energy Used in Intra-Company Business Including Line Losses, Kw.-Hr.			
	1924 Thousands	1923 Thousands	Per Cent Inc.	1924 Thousands	1923 Thousands	1924 Thousands	1923 Thousands	1924 Thousands	1923 Thousands	1924 Thousands	1923 Thousands	1924 Thousands	1923 Thousands	1924 Thousands	1923 Thousands
May	*4,413,107	4,265,190	3.5	3,563,107	3,442,690	757,000	655,500	2,280,507	2,274,700	545,600	512,490	850 000	824,500	732,500	602,000
June	*4,193,699	4,164,327	0.8	3,384,699	3,360,827	749,000	649,000	2,106,499	2,216,717	529,200	495,110	809,000	803,500	692,990	600,200
July	*4,241,771	4,179,631	1.4	3,423,271	3,371,631	757,000	655,000	2,126,271	2,199,131	540,000	517,500	818,500	808,000	660,000	535,000

* Data on "energy generated" are those collected and published by the United States Geological Survey for all public utilities, minus such data as are collected on energy generated by electric railway companies, reclamation service and manufacturing plants. The data are, therefore, for the electric light and power industry only.

TABLE II—CENTRAL-STATION FINANCIAL OPERATIONS FOR THREE MONTHS IN THE UNITED STATES
(100 per Cent of the Industry)

Month	Gross Revenue from Sale of Energy†			Operating and Maintenance Expenses‡			Operating Ratio					
							Steam Plants		Hydro Plants		Combined Steam and Hydro Plants	
	1924 Thousands	1923 Thousands	Per Cent Increase	1924 Thousands	1923 Thousands	Per Cent Increase	1924	1923	1924	1923	1924	1923
May	$108,400	$100.100	8.4	$49,250	$45,700	7.8	51.7	52.8	32.0	26.2	44.9	44.3
June	103,800	97,500	6.3	47,000	43,730	7.4	52.1	54.1	26.9	34.0	46.4	43.3
July	99,000	93,600	5.7	49,100	45,300	8.2	56.1	55.3	28.1	27.9	48.1	46.1

† Aggregate gross revenue from actual consumers and sales to other public utilities for resale, involving a certain amount of duplication.
‡ Do not include interest, taxes, depreciation or sinking fund.

other primary industries of the country, which for the most part had been operating below normal since early in the year. The ability of the central station to maintain activities above the estimated normal despite greatly reduced industrial power requirements throughout the country has been due almost entirely to the large increase in number of domestic lighting customers during the past two years. Incomplete data indicate that approximately three million new domestic lighting customers were added to the distribution lines in the past twenty-four-month period. This type of customer reflects only very slightly any depression which may be affecting industrial activity as a whole.

A similar abnormal decrease in the gross revenue of the industry has also been reported since February. The total gross revenue has decreased from 18.7 per cent above normal in February to 5.6 per cent below normal in July, representing a drop in revenue of slightly over a million dollars per day, a decrease of 26.2 per cent. This is the first time that the industry has reported gross revenue under the estimated normal since August, 1922, and the decrease reported since February is the greatest drop in revenue which has ever been reported by the industry. Despite this large decrease, however, the gross revenue in July was 5.7 per cent above that reported for July last year, bringing out very clearly the inherent ability of the industry to overcome general economic conditions by growth within the industry itself.

Letters from Our Readers

Ontario Hydro-Electric Power Scheme Could Not Be Duplicated Here

To the Editors of the ELECTRICAL WORLD:

In a recent issue of an Ithaca (N. Y.) paper I notice an interview* with my very good friend and former professor, Vladimir Karapetoff. The views he is said to hold on the public ownership of power and transmission companies are not novel. However, he quotes from the so-called "excellent example" of the Hydro-Electric Power Commission of Ontario. It so happens that I had the pleasure of working with this commission for something more than seven years and for the officials and staff hold a very warm regard, both from a personal and a technical standpoint. Only this summer I greatly enjoyed renewing old acquaintances in Ontario.

Professor Karapetoff's reference to this scheme, however, is quite misleading if one analyzes conditions in Ontario as compared with conditions in the United States. In the first place, the form of government in the Dominion is radically different, permitting legislation which would be virtually impossible in this country. The people also have viewed power matters from a different angle, due to the lack of fuel in Ontario and their dependence on American fuel. There is also no doubt that many of the private companies in Ontario brought the Hydro-Electric Commission upon themselves in their refusal or inability to extend their lines and to reduce their rates. Their attitude toward the public was evidently not one of true service. It should also be remembered that Ontario is an immense province, practically self-contained, and does not work with any other province on hydro matters, whereas in the United States we have almost independent states with their varying laws, which would make an extensive power system in my opinion absolutely unworkable, even if we shut our eyes to the regrettable political situation in many of the states. Moreover, we do not have a responsible form of government as they do in Ontario, and there are so many radical political differences that one who studies this subject in an unbiased way must soon be entirely discouraged.

This also must be said for the Hydro-Electric Power Commission of Ontario, namely, that the father of this system and still its undoubted leader is Sir Adam Beck, a man of tremendous energy, vision and fearlessness. Sir Adam took up this power matter at the critical moment and put it across in a way which reflects great credit upon him and his followers. Despite American critics, many of whom have shown poor taste in their attacks, the Hydro-Electric Commission for the people of Ontario has proved to be a blessing and a source of strength. Its success in the future, after Sir Adam and his immediate supporters shall have passed from the picture, is, however, not so certain, although at the present time it is one of the most important factors in Ontario's industrial life. The people of that province have it in their own power to keep the commission clean, to keep it out of politics and to continue the benefits derived from its extensive plants and transmission systems. This is a matter which concerns the people of Ontario.

It is very easy to jump to conclusions and cite this successful enterprise as an evidence of the possible application of similar schemes to conditions in the United States. Both the advocates and the opponents of government or state ownership of public utilities in this country have used the Ontario commission as an example, and each side has drawn its own conclusions therefrom. My observations lead me to believe that the advocates of private ownership of public utilities in this country need not and should not engage in bitter controversy regarding Ontario's system. A more calm and detailed analysis of our conditions and Ontario's conditions should show to enlightened engineers, and politicians as well, that we in this country have to meet very different conditions from those found across our northern boundary. It should also be remembered that the Hydro-Electric Commission was started at a time when power transmission in Ontario was practically in its infancy, whereas now in this country power transmission systems have reached a very high state of development, and that state or national publicly owned systems in all probability would seriously affect the tremendous investment of private capital in utilities.

All of us know that in times past—and in some cases even today—private utilities have not been or are not conducted in the best interest of the people as a whole. This is an internal matter which must be handled in each case on its own merits, and I sincerely hope that Professor Karapetoff, delightful as he is personally and with his splendid technical mind, will not convince a large following that the Ontario Hydro-Electric Power Commission can be duplicated successfully in this country. These remarks of mine are meant in the friendliest spirit and in the hope that acrimonious criticism on both sides may give way to more calm business judgment.

F. F. ESPENSCHIED.
Commercial Truck Company,
Philadelphia, Pa.

*Entitled "Public Control of Power Urged by Karapetoff."

Central Station and Industrial Practice

Brick-to-Brick Bond for Furnace Walls

BELIEVING that many of the troubles associated with the deterioration of furnace linings have been due to the non-homogeneity of the walls, some engineers have been laying up the brick walls of furnaces with a brick-to-brick bond. In one installation just being completed in the Southwest, where ventilated wall construction is being employed, the furnace lining is being laid up in this manner. The wall is 13½ in. thick, bricks of this length being laid with their longest dimension at right angles to the furnace walls.

In laying the bricks a clearance of only $\frac{1}{32}$ in. is allowed between them. After a course of bricks has been laid any rough places on them are ground off with a portable grindstone, consisting of a carborundum disk attached to a ⅓-hp., 3,600-r.p.m., Van Doorn portable drill. The surfaces of bricks to be laid in the next course are similarly ground off, dipped in a thin mixture of fireclay and laid in place.

Horizontal Supports Used

The lower portions of three walls of the boiler setting—at the two sides and at the downtake end—are relieved of supporting the weight of the upper portion of these walls by horizontal beams framed into the main boiler columns, placed above the level of the lower tubes. It was the intention of the design that this lower portion of the walls should expand and contract freely without disturbing the remainder of the setting and therefore with the least effect on wall integrity and alignment. Horizontal rails are provided about every six feet, being held in alignment by the buckstay columns but without rigid attachment thereto, the function of the rails being to maintain wall alignment and at the same time to permit free expansion and contraction.

This type of construction and the greater care taken in obtaining a close bond between firebrick combined to increase the cost of furnace construction materially as compared with the more usual form and method of furnace construction. In fact, the increased cost due to greater care taken in selecting, grinding and laying up the brick amounted to about 50 per cent of the contractor's original estimate.

The floor of the furnaces in this plant, which is designed for oil firing, is built up of layers of concrete, sand, "nonpareil" brick, asbestos mill board, "silocel" compound, brick laid flat and brick on edge. The sand is 2 in. thick, the "nonpareil" brick 2 in. thick, the asbestos mill board ¼ in. and the "silocel" compound 2 in.

In other plants where similar wall construction has been employed it has been noted after operation of the furnace for some time that openings develop between the bricks despite the small original clearance. These openings are wedge-shape and extend back into the wall only a short distance, but still in some cases are large enough to admit the fingers of one hand. Some persons who have speculated on the cause of this suggest that the bricks, having no mortar between them to give when the bricks expand and contract, expand in longitudinal direction. However, this theory has not been substantiated by any tests so far.

In some new installations where ventilated wall construction will be employed it is planned to use a 9-in. wall instead of 13½-in. brick to facilitate cooling. The extra thickness of furnace walls is not so important as in an unventilated furnace wall, because the heat passing through the furnace lining is recovered in the ventilating air which supports combustion in the furnace eventually.

Inspection of Substation Transformers

ACCORDING to instructions formulated by the Worcester (Mass.) Electric Light Company for the routine inspection of transformer equipment, the following should be kept in mind in caring for substation transformers:

Substation transformers shall be inspected for loose connections, damaged bushings and other visible defects when the periodical megger tests are made. The transformer repair man shall collect a sample of oil from each such transformer on the third Monday in September and deliver it to the service engineer.

The service engineer shall examine the samples and have a breakdown test made on each sample by the meter department. If the oil in any sample on being allowed to settle shows the presence of much sediment, or if breakdown occurs at less than 16,500 volts, the service engineer shall have the oil in the transformer from which the sample was taken filtered and the filtered oil shall show a satisfactory breakdown test before being replaced in the transformers. The result of these tests shall be recorded on the corresponding "Substation Transformer Record" sheets in the general superintendent's office under the direction of the service engineer.

Rubber Goods Tested Daily for Safety

By C. B. Hefner
Superintendent of Distribution Dallas (Tex.) Power & Light Company

WORK by linemen of the Dallas Power & Light Company on energized 4,000-volt circuits is not permitted unless the men use rubber blankets and rubber gloves protected by leather ones. These rubber goods are tested for voltage breakdown each day before they are issued for use. The rubber blankets are tested at 15,000 volts between metal plates, the voltage being brought up from zero to 15,000 in one and one-half minutes and retained at that value for three minutes. Tests on rubber gloves are conducted in the usual way, the gloves filled with and immersed in water, at 10,000 volts.

Linemen's belts are tested every month by the impact test. This is used because it has been found that flaws which cannot be detected by the eye and which might endanger the life of linemen readily manifest themselves under this test. The apparatus for testing the belts consists essentially of a frame supporting a round block about which one-half of the belt can be looped and buckled as when in use. A similar block is inserted in the opposite half of the belt. This block is attached to a weighted lever, which may be lifted to a definite height and then dropped to produce the impact. The weight on the end of the lever is sufficient to exert a steady pull of 500 lb. on this block. With this test most of

the flaws in the belt buckles or snaps have been found.. No failures of belts have occurred during service since the test was inaugurated.

Non-Stop Run of Diesel for 201 Days

THE high efficiency of the Diesel engine is already well known, but that it is able to operate continuously without stop is not so well known. Reliability is usually more important in any engine than efficiency. To be truly economical the engine must be both efficient and capable of reliable service. The reliability of an engine depends largely upon its ability to operate any desired length of time without shutdown.

Owners of engines and users of power may therefore be interested in a continuous run of 201 days, under actual working conditions, reported by the Worthington Pump & Machinery Corporation for a Worthington-Snow Diesel engine. The engine is a standard 562-hp., four-cycle, air-injection type operating at 225 r.p.m. and is used by the city of Horton, Kan., for the city lighting and power purposes, driving an alternating-current generator in parallel with another unit. The engine has three cylinders, each 22½ x 22½ in. and of the so-called square type. The pistons are oil-cooled. Lubrication is forcibly fed to all parts of the engine. The operating data are given in the accompanying table.

ECONOMY OF DIESEL ENGINE OPERATING CONTINUOUSLY FOR 201 DAYS

Length of run	201 days, 4¾ hours.
Output	554,240 kw.-hr.
Fuel oil	81,623 gal., 24-26 gravity, average cost $1.50 per barrel.
Lubricating oil	911 gal., average cost 65 cents per gallon.
Average load from midnight to 8 a.m.	60 kw.
Average load from 8 a.m. to midnight	150 kw.
Peak load	280 kw.

Overhead Distribution Construction

Standardized Practice as Developed and Used by the
WEST PENN POWER COMPANY, PITTSBURGH

Lighting and Power Circuit Secondaries

SECONDARY power circuits should be kept separate from lighting circuits and should be supplied by separate transformers. As an exception—on 6,900-volt and 2,300-volt circuits only—under special conditions where it is difficult or expensive to supply lighting service from lighting secondaries, it may be supplied from one of the power transformers.

Lighting Secondaries.—The three-wire, 230/115-volt, single-phase type of secondary shall ordinarily be used to supply domestic and commercial lighting customers. However, two-wire secondaries may be used in thinly settled sections, leaving the installation of the third wire until it is required by the addition of new customers. Short two-wire branches may be run from three-wire secondaries. Care should be taken to balance the load between the outside wires on the three-phase secondaries both in number of services and in distance from the transformer.

Secondary lighting circuits shall be designed to give a drop of approximately 3 per cent from the transformer secondary terminals to the end of the secondary in any direction. The size of wire necessary to keep within this voltage drop in ordinary lighting circuits may be roughly determined from Table XXI, which is based on the fact that the same secondary voltage drop will be caused by one house ten spans from the transformer as by ten houses one span distant, five houses two spans distant, etc., provided that the average load per house and length of span are the same in each case. The table shows values for two types of houses and the proper type should be selected for the district under consideration. The table is based on an average span length of 125 ft. If the actual average span length varies very much from this, the total "house spans" as calculated should be multiplied by the ratio of the actual average span to 125 ft. before using the table to determine the wire size necessary.

An example of the method of using this table follows: First make a sketch of the proposed line showing all the poles and houses, as shown in Fig. 86. The "house spans" for each pole are written by the pole and are calculated by multiplying the number of houses connected to a pole by the number of spans between pole and transformer. If any house is expected to draw an unusually large load, it should be figured as two or three houses. The sum of all the "house spans" in this case amounts to fifty-four, and since the average span is 150 ft., the equivalent "house-spans" should be (150/125) × 54 = 65.

Assuming that the houses in this example are in a good residential district, the value for large houses will be used from the table. For sixty-five "house spans," therefore, one should use a No. 6 three-wire secondary. It is assumed that the services will be connected so as to balance three-wire secondaries, not only in the houses, but also in "house spans" from the transformer as nearly as possible.

TABLE XXI—SIZE OF WIRE FOR SECONDARIES ALLOWING 3 PER CENT DROP

Secondary Wire Size, No.	Secondary Type	Maximum "House Spans" Large Houses*	Maximum "House Spans" Small Houses†
No. 6	Two-wire	23	46
No. 6	Three-wire	67	133
No. 4	Three-wire	100	200
No. 2	Three-wire	133	266

*150 watts average load.
†75 watts average load.

Only the houses on one side of the transformer pole are shown. In practice, of course, the transformer should be installed at the center of its load. To accomplish this in any case, make a complete sketch and then select a pole for a transformer location. Calculate the "house spans" on each side of this pole as above. If they are not very nearly equal, try another pole until a location is found which will make them as nearly equal as possible. It should be noted that load connected to the transformer pole does not enter the calculations for determining the size of wire, although, of course, this load must be considered when selecting the size of transformer.

More accurate determination of the size of wire necessary may be made from the curves given in Figs. 87 and 88. To use these curves estimate the load for each house and its distance from the transformer and multiply them together to get the "load distance" for that house. Add the estimated loads and call the total load in kilowatts K. Now add the "load distances" and call the total in kilowatt-feet KD. Divide KD by K and get D, the equivalent distance in feet to which a concentrated load equal to K may be carried. Now, using the proper set of curves, find the point of intersection of K and D. If this point does not fall almost exactly upon the curve for any particular wire size, the wire size for the curve next above the point shall be used.

In cases where a very heavy load is to be supplied over a short distance larger conductors than shown by the

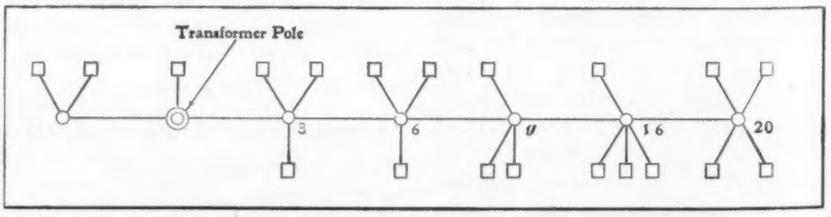


FIG. 86—METHOD OF DETERMINING THE SIZE OF SECONDARIES

TABLE XXII—ALLOWABLE CURRENT-CARRYING CAPACITIES OF WIRES

Wire Size, No.	Current in Amperes
4/0	325
0	200
2	125
4	90
6	70
8	50

*150 watts aveaage load.
† 75 watts average load.

curves may be required because of heating in the conductor. The current-carrying capacities of copper conductors in the open are given in Table XXII. In general No. 6 wire will be adequate to give proper voltage regulation for most lighting secondaries. In special cases, however, lighting secondaries as large as No. 2 wire may be required.

Polyphase Power Secondaries.—In estimating the load for power secondaries, the procedure is the same as for lighting secondaries except that the power load, in general, is more easily estimated as the motors to be supplied and their ratings are definitely known. The curves for three-phase secondaries (Figs. 89 and 90) are based on an assumed voltage drop of 5 per cent and an assumed load power factor of 80 per cent, which will probably be about the average for ordinary motors. In cases where greater voltage drop is permissible, the distance which the load may be carried will vary directly with the permissible per cent drop. For example, with 10 per cent drop, any load can be carried twice the distance found from the curves for any given wire size. If any load of unusually low power factor is expected, special allowance for proper capacity must be made in each case. This can best be done usually by assuming that the load to be supplied will be greater than the actual rating and then using the curves in the ordinary manner.

Single-Phase Power Secondaries.—For single-phase power secondaries follow the same procedure as in the above cases except to use the curves for 230 volts, single-phase, as shown in Fig. 91.

FIGS. 87 TO 91—CURVES FOR CALCULATING WIRE SIZE FOR LIGHTING AND POWER, SECONDARY SERVICES

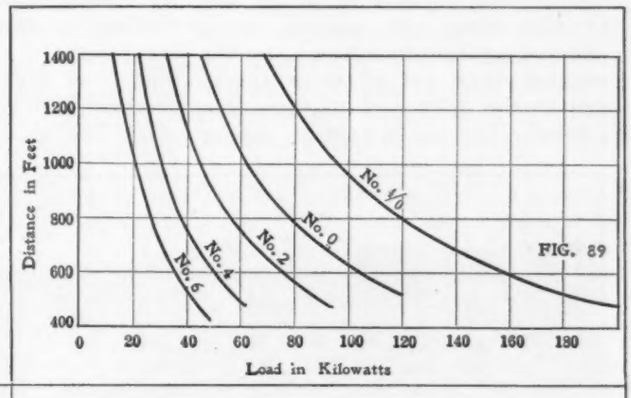
Fig. 87—Load curve for 230/115-volt in two phase. Curve shows the distance in feet, *D*, that any load in kilowatts, *K*, can be transmitted with 3 per cent voltage drop on line, allowing for unbalance of three-wire circuit. Voltage at load, 230/115 volts; spacing of wires, 4 in.; power factor of load, 95 per cent; 60-cycle current.

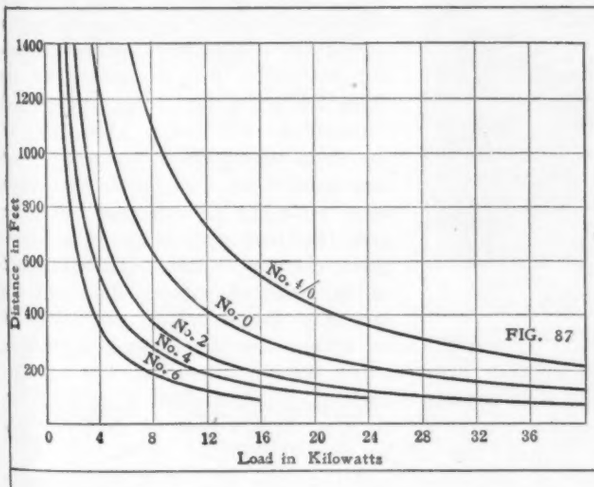
Fig. 88—Load curves for 115-volt single-phase. Curves show distance that any load in kilowatt, *K*, can be transmitted with 3 per cent drop on lines. Voltage at load, 115 volts; spacing of wires, 8 in.; power factor of load, 95 per cent; 60-cycle current.

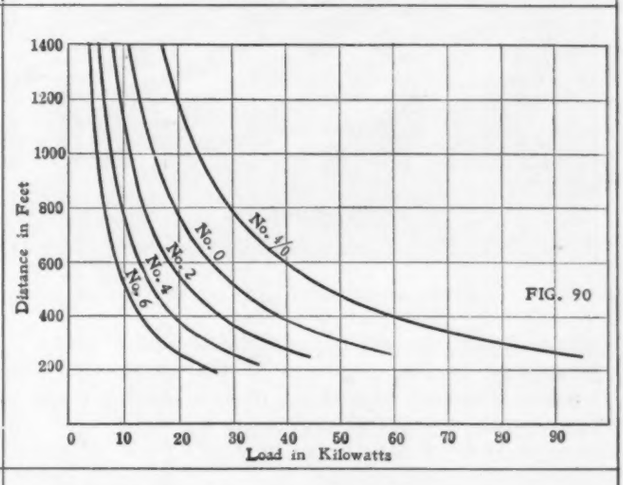
Fig. 89—Load curve for 460-volt, three-phase power. Curves show the distance in feet, *D*, that any load in kilowatts, *K*, can be transmitted with 5 per cent drop on line. Voltage at load, 460 volts; equivalent spacing of wire, 5.05 in.; power factor of load, 80 per cent; 60-cycle current.

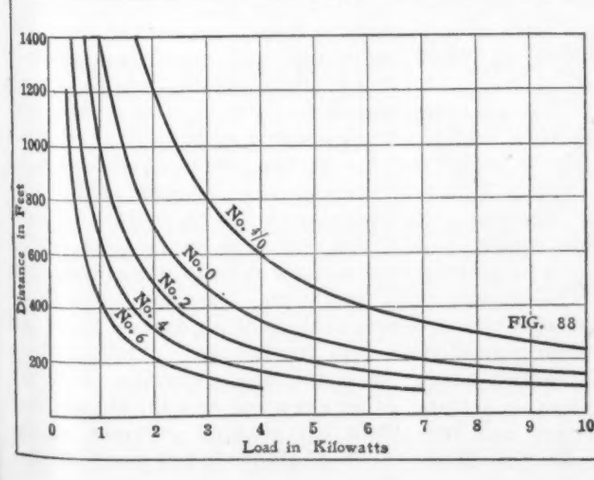
Fig. 90—Load curves for 230-volt, three-phase power. Curves show distance in feet, *D*, that any load in kilowatts, *K*, can be transmitted with 5 per cent voltage drop on lines. Voltage at load, 230 volts; equivalent spacing, 5.05 in.; power factor of load, 80 per cent; 60-cycle current.

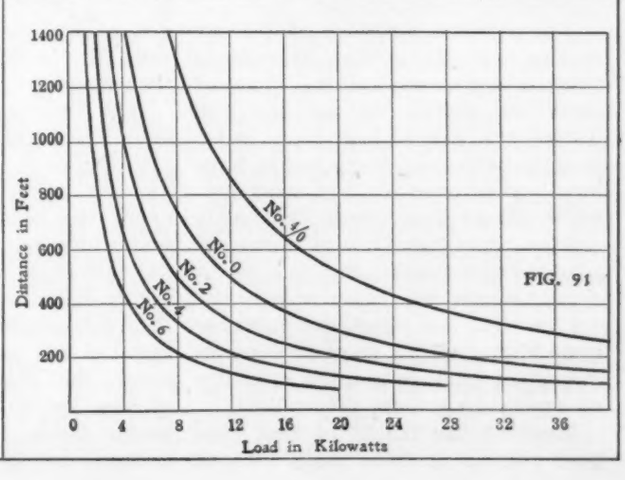
Fig. 91—Load curve for 230-volt, single-phase power. Curves show distance in feet, *D*, that any load in kilowatts, *K*, can be transmitted with 3 per cent drop on lines. Voltage at load, 230 volts; spacing of wires, 4 in.; power factor of load; 94 per cent.











Routine Running Repair Lengthens Life of Electric Trucks

By PAUL KARST
Superintendent American Railway Express Company, Philadelphia

THE maintenance of electric trucks, known ordinarily as overhauling, is a separate item in the analysis made of electric truck operation carried on systematically by the American Railway Express Company. This work is done in regular overhauling shops of the company. As in all business, the trucks are depreciated over a certain period of years, known as their life, a sufficient reserve being set aside to allow for their replacement at the end of that time, this reserve being charged against operation. In the regular daily use of these trucks and in the daily care of them this company has an inspection system which keeps the officials fully informed as to the condition of the trucks. Through this daily inspection system and defect reports it is possible to keep the trucks in what is called running repair.

AMERICAN EXPRESS COMPANY'S FLEET OF ELECTRIC TRUCKS

The physical condition of the car is the only thing that determines when it needs overhauling. Physical condition depends on age and the duties the truck has been called upon to perform. Some trucks have easy routes year in and year out, while others may work on double shifts or particularly hard routes. In all cases the vehicles finally come to a point where they begin to show excessive wear and running repairs become high. At this point a thorough inspection is made and the necessity of overhauling them determined.

Many of the trucks of this company run six or seven years without overhauling, others that work in double shifts run only from three years to five years. It has been found, however, that with a good inspection system and by sending the car to the shop for general repairs about every three years the period between regular overhauls is greatly increased. Before overhauling a thorough inspection is made of the truck and the approximate cost of the work determined. Based on a four-year period, the cost of overhauling an electric truck is such a small part of the replacement cost that it is far more economical to overhaul than to replace, and when, after overhauling, the truck has again given four years of service, it is often found that another overhaul is cheap compared with replacement, even when depreciation is in favor of replacement. These trucks actually carry on year in and year out, after overhauling, with practically the same efficiency as when they were new.

If it be determined that an overhaul is to be made, the truck is taken into the shop, the body is removed and sent to the body repair department, the battery is removed and sent to the battery department, and the bare chassis is placed in position for tearing down. The chassis is then disassembled and all units are removed and sent to their respective places; that is to say, a certain group of men handle the rears, a certain group handle the motors and controllers, another handle the steering gear. The chassis men then rebush all parts, reassemble the axle, replace, if necessary, the wheel bearings, tear out frame members and re-rivet wherever necessary, install new battery cradles of removable type if desired and rewire the truck. By the time this has been done units have been obtained from the various groups mentioned above, and these units are again assembled in the truck, which is then sent to the paint shop, where it is painted and the body placed on it. The battery in the meantime has been thoroughly cleaned and painted with an insulating paint, flushed, tested, charged and repaired throughout, and, if of the lead type, resealed if necessary, and, if of the Edison type, supplied with a new solution if necessary. The battery is then placed in its cradle and the truck is again ready for service.

It takes about two weeks to overhaul a truck completely, including body and painting, provided of course, that necessary parts are obtainable. Present-day electric trucks, however, are serviced in such a manner that there is very little, if any, delay in securing the necessary parts. On an average the cost of overhaul runs about 20 per cent or less of the replacement value, including battery. It is necessary to replace batteries, in from three and one-half to six years, according to the type which is being used; but this period is not fixed, and very often both the Edison type batteries and the lead type give far above their estimated life. This cost of replacement of battery does not enter into the overhaul cost, but is an actual operating expense, which, when spread over the life of the battery, is figured as a part of the running repair cost of that particular type of truck.

All overhauling and maintenance work is done along similar lines, that is to say, unit repair and overhaul spare units which can be readily placed in service in a broken-down truck are carried in stock at all times. This system works to the best advantage in every case and, while involving a slight outlay of extra funds, saves so much time that it more than offsets the investment. There is nothing complicated in the overhauling of an electric truck, and except for the men actually engaged in motor and controller work and other electrical jobs the chassis work does not require workmen of pronounced ability in any particular line.

Central Station Business

Road Markers Advertise Utility's Securities

APPEALING to people owning automobiles, the Oklahoma Gas & Electric Company is erecting 116 signposts on the main-traveled roads near Oklahoma City, El Reno and Shawnee. In Oklahoma the marking of automobile highways is left entirely to private concerns, which capitalize on the advertising value of road markers by utilizing a disk at the top as shown in the accompanying illustration. As there is much open country in Oklahoma and the traveler needs information to guide his steps in the right direction, the Oklahoma Gas & Electric company has found it beneficial to use this form of advertising in offering preferred shares to its customers.

SIGNPOSTS CALL ATTENTION TO UTILITY SECURITIES

Electrical Show Develops Appliance "Prospects"

REPORTS to Cyrus Barnes, general sales manager of Charles H. Tenney & Company, from exhibitors at the recent Hampton Beach (N. H.) electric show indicate that cash sales of appliances at the show totaled $3,500, the cost of the show being about $2,000. The show ran for two weeks and the total attendance was 32,000. Twenty-four exhibitors participated and "leads" for appliance sales were obtained from states as far away as New Jersey and even Florida.

One electric range maker reported three direct sales of ranges and thirty-six "prospects," and one washing-machine maker booked 226 leads. Central-station companies participating included the Exeter & Hampton Electric Company and Portsmouth Power Company of New Hampshire and the Haverhill (Mass.) Electric Company.

Economies of Centralized Machine Billing

BY H. C. BRADSHAW
Secretary Virginia-Western Power Company, Clifton Forge, Va.

THE making and posting of bills is one of the most perplexing problems a central-station auditor has to face. The amount of time consumed by these operations is an important factor, for bills must be mailed out promptly, and the work must be done in such a way that errors will be reduced to a minimum.

Our company, the Virginia-Western Power Company, with headquarters at Clifton Forge, Va., was confronted with a particularly perplexing problem of billing in that we serve about fourteen thousand customers in Clifton Forge and seventeen towns nearby. Such a situation meant meter reading in eighteen towns, posting up accounts from those readings, mailing the statements, handling the payments and posting of credits. The problem was complicated and it gave us considerable trouble, but the adoption of a system of centralized billing has solved our billing problem.

For some time we had struggled along with a system of sub-offices in the various communities we served. Each sub-office took care of its own meter reading, billing, collections and account keeping, in addition to the regular work.

This arrangement did not work well. We tried systematizing the sub-offices, but that didn't help very much. Then it occurred to us that we were approaching the problem from the wrong angle, that instead of trying to systematize the sub-office we should concentrate all the work of billing and handling of credits. Thereupon we decided to centralize our billing. It was obvious that in order to do that we needed a system that would combine unusual speed and efficiency with extreme simplicity. And that is just what we now have.

After a good deal of investigation in the field of mechanical equipment for billing and posting, we worked out a system whereby two men in the home office at Clifton Forge, using two Burroughs public utility machines, handle all the billing for our fourteen thousand customers in the eighteen towns, and do it without any confusion or overtime, without the congestion that follows piled-up work, and without the errors that are usually the bane of billing consumers' accounts. Those two men do the work formerly done by eight—we have eliminated six salaries by our system of centralized billing.

We use the plan of continuous meter reading and continuous billing, which means that our meter readers are at work in one or more of the communities we serve every day, and that every day their route books are mailed in to Clifton Forge, where the operators post them up. This spreads the work of posting over the whole month and does away with congestion and end-of-month overtime and confusion.

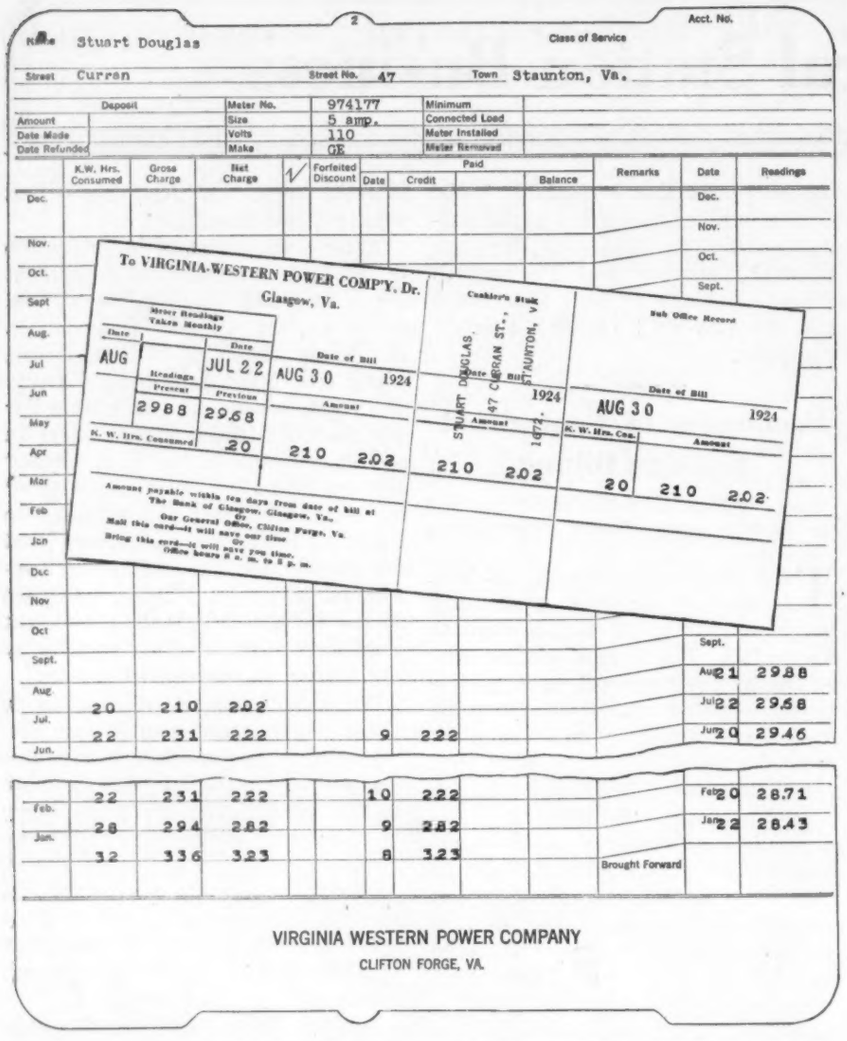
The bills we use are cards, 3½ in. x 8 in., divided into three sections—one for the customer as his receipt when the bill is paid, one for our central office and one for the sub-office.

MACHINES LABOR SAVERS

Though the two operators who do the billing and accounting are at work eight hours a day and every working day, there is, nevertheless, no confusion. The machines have so cut down the labor of billing that the operators average 800 bills and postings daily. But one of the men one day set a record with 1,175 bills and postings.

We are able to handle our billing and accounting this way because so much of the work is done automatically by the machines without any attention from the operator. That is the outstanding feature of the system we use, and it speeds up the work greatly.

Another highly important feature is that we have virtually eliminated errors in posting. Prior to the installation of our present system,



Name Stuart Douglas — Class of Service — Acct. No.

Street Curran — Street No. 47 — Town Staunton, Va.

Deposit		Meter No.	974177	Minimum	
Amount		Size	5 amp.	Connected Load	
Date Made		Volts	110	Meter Installed	
Date Refunded		Make	GE	Meter Removed	

	K.W. Hrs. Consumed	Gross Charge	Net Charge	✓	Forfeited Discount	Paid Date	Paid Credit	Balance	Remarks	Date	Readings
Dec.										Dec.	
Nov.										Nov.	
Oct.										Oct.	
Sept.										Sept.	
Aug.										Aug. 21	2988
Jul.	20	210	202							Jul. 22	29.68
Jun.	22	231	222			9	222			Jun. 20	29.46
	22	231	222			10	222			Feb. 20	28.71
Feb.	28	294	282			9	282			Jan. 22	28.43
Jan.	32	336	323			8	323		Brought Forward		

To VIRGINIA-WESTERN POWER COMP'Y, Dr.
Glasgow, Va.

Meter Readings Taken Monthly

Date	Readings Present	Date	Previous
AUG	2988	JUL 22	29.68

K. W. Hrs. Consumed 20

Date of Bill AUG 30 1924

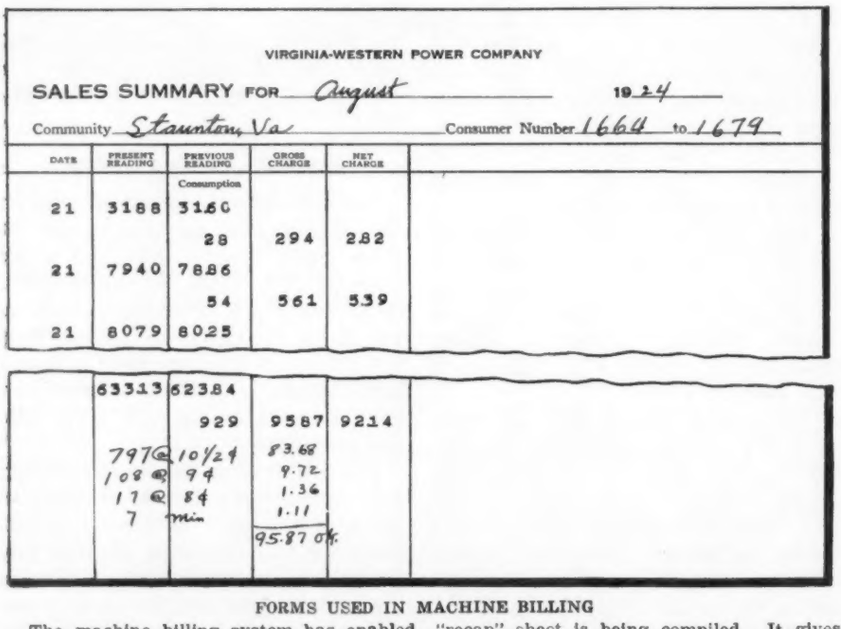
Amount 210 2.02

Amount payable within ten days from date of bill at The Bank of Glasgow, Glasgow, Va.
Or
Our General Office, Clifton Forge, Va.
Mail this card—it will save our time
Or
Bring this card—it will save you time.
Office hours 8 a. m. to 5 p. m.

Cashier's Stub
STUART DOUGLAS. 47 CURRAN ST., STAUNTON, VA.
Date Bill 1924.
Amount 210 2.02

Sub Office Record
Date of Bill AUG 30 1924
K. W. Hrs. Con. 20 Amount 210 2.02

VIRGINIA WESTERN POWER COMPANY
CLIFTON FORGE, VA.



VIRGINIA-WESTERN POWER COMPANY

SALES SUMMARY FOR August 1924

Community Staunton, Va Consumer Number 1664 to 1679

DATE	PRESENT READING	PREVIOUS READING	GROSS CHARGE	NET CHARGE
		Consumption		
21	3188	3160		
		28	294	282
21	7940	7886		
		54	561	539
21	8079	8025		
	63313	62384		
		929	9587	9214
	797 @ 10½		83.68	
	108 @ 9		9.72	
	17 @ 8		1.36	
	7 min		1.11	
			95.87 Net	

FORMS USED IN MACHINE BILLING

The machine billing system has enabled the Virginia-Western Power Company to handle with two clerks and two Burroughs public utility machines the billing for the company's fourteen thousand customers in fourteen communities. The ledger bill and "recap" sheet are made up at one operation, and the use of the machine makes a great part of the work automatic. As the bill is being made up a carbon-copy "recap" sheet is being compiled. It gives the operator a check on the work and proof of posting as subtracting the total of previous reading from present reading gives total consumption. Then, multiplying by the rate as shown by the pen-and-ink figures at the bottom of the form, gives the gross charge. By that means the operator in two minutes can prove the accuracy of the work.

when we used the old-style method of pen-and-ink posting, errors kept occurring, and errors meant, of course, double work. But the elimination of detail work done by the posting clerks has also eliminated the possibility of error.

A feature of the system that helps prevent error is that while the machine is posting ledger and bill at the one operation it is posting, also, a "recap" sheet that is a printed proof of posting. When one of these sheets is filled up an operator can prove the accuracy of his work in two minutes, and if he has made an error he can locate it instantly. He does not have to hunt for it.

The bills are payable in the communities in which the customers live. When we get from the sub-offices the stubs which are proofs that the bills have been paid the operators of the machines post the credits in proper columns of the customers' ledgers. It is a fast and error-proof method of posting credits, for a "recap" sheet, made up in the same way as the "recap" sheet in posting of bills, provides a check of work and a proof of credit posting. The system we use is simplicity itself and has solved a most perplexing accounting problem.

Practical Applications of Electric Heat

BY WIRT S. SCOTT
Manager Industrial Heating Section, Westinghouse Electric & Manufacturing Company

UP TO the present time there has been a tremendous amount of development and investigational work done for the purpose of satisfactorily solving industrial applications of electric heat. This development has gradually assumed a logical trend, with the result that there is now on the market a large amount of standard apparatus, and there have been disclosed and perfected a sufficient number of standard applications to warrant central-station companies concentrating their major attention on developing industrial heat applications for the next four or five years.

At the present time there are what might be relatively termed desirable and undesirable applications. The desirable ones are those in connection with which standard apparatus has been developed and satisfactory operating results have been obtained. Therefore, in developing the power load in any territory, power-sales en-

gineers will make more progress and meet with less sales resistance by confining their efforts to standard applications. An enormous amount of time can be spent in trying to solve some interesting special process, but the final result may be the complete abandonment of the project owing to the trend of development or the inability at the time to show an economy.

The accompanying data will be helpful in determining the applications on which the central stations should concentrate their attention for the next few years. Those marked desirable from both the electrical manufacturers' and central stations' viewpoints may be applied with assurance that the apparatus and application can be made an economic success with the present power rates offered by most central stations.

Status of Industrial Electric Heating Applications

Applications	Apparatus	Temperature Range, Deg. F.	Load Range, Kw.	Power Factor, Per Cent	*Status From Viewpoints of: *Standard or Special	Electrical Manufacturers	Users
Air heating	Air heaters, space heaters, oven heaters	70 to 1,000	0.5 to 3,000	99+	Standard	Desirable	Doubtful
Aluminum annealing	Oven or furnaces	700 to 800	5 to 300	99+	Standard	Desirable	Desirable
Armature baking	Ovens, electric	200 to 260	10 to 90	99+	Standard	Desirable	Desirable
Assaying	Electric furnaces	1,000 to 2,100	0.5 to 100	99+	Standard	Desirable	Desirable
Asphalt melting	Immersion, clamp-on and furnace elements	275 to 400	10 to 100	99+	Both	Desirable	Desirable
Brass and copper melting	Arc or induction furnace	1,900 to 2,400	50 to 1,000	60 to 92	Both	Desirable	Desirable
Bread and pastry baking	Bakery ovens	325 to 500	325 to 200	99+	Standard	Desirable	Desirable
Baking ovens	Core baking, brush and lamp cement, etc.	200 to 500	10 to 500	99+	Standard	Desirable	Desirable
Candy making	Chocolate urns, warmers, pots, etc.	200 to 400	0.5 to 25	99+	Standard	Desirable	Desirable
Branding irons	Branding irons and heaters	400 to 700	0.1 to 2	99+	Standard	Desirable	Desirable
Battery-plate molding	Steel-clad and space heaters	450 to 600	0.5 to 3	99+	Standard	Desirable	Desirable
Cyanide pot heating	Furnace elements	1,300 to 1,600	5 to 30	99+	Special	Either	Doubtful
Compound pot heating	Steel-clad	250 to 400	1 to 6	99+	Standard	Desirable	Desirable
Cereal drying	Ovens and oven heaters	200 to 600	10 to 500	99+	Standard	Desirable	Doubtful
Coffee roasting	Special heaters	500 to 650	1 to 5	99+	Special	Doubtful	Doubtful
Cigarette making	Cartridge heaters, steel-clad	150 to 250	0.1 to 2	99+	Standard	Desirable	Desirable
Cheese making	Cartridge heaters, steel-clad	150 to 200	0.5 to 5	99+	Standard	Desirable	Doubtful
Chemical drying	Ovens, oven heaters, furnaces	150 to 1,000	1 to 150	99+	Standard	Desirable	Doubtful
Ore concentrate drying	Ovens, oven heaters, furnaces	200 to 400	5 to 50	99+	Standard	Desirable	Doubtful
Copper and brass annealing	Ovens, oven heaters, furnaces	1,000 to 1,200	10 to 100	99+	Standard	Desirable	Desirable
Chemical liquid heating	Hot plates, immersion units, etc.	200 to 600	1 to 10	99+	Standard	Either	Doubtful
Cigar-lighter heating	Space heaters	1,500 to 1,800	0.1 to 1	99+	Special	Doubtful	Doubtful
Dough-proofing boxes	Oven heaters, proof boxes	95 to 110	0.5 to 5	99+	Standard	Desirable	Doubtful
Doughnut cookers	Steel-clad heaters	350 to 450	0.5 to 6	99+	Special	Either	Doubtful
Drying ovens	Ovens and oven heaters	100 to 500	1 to 200	99+	Standard	Desirable	Desirable
Dye heating	Cartridge and steel heaters	200 to 700	0.2 to 10	99+	Standard	Desirable	Doubtful
Dental-works heating	Hot plates, furnaces	200 to 2,000	0.2 to 2,000	99+	Standard	Desirable	Doubtful
Enamel-oven heating	Ovens and oven heaters	150 to 500	5 to 2,000	99+	Standatd	Desirable	Desirable
Fruit drying	Ovens and oven heaters	100 to 200	5 to 100	99+	Standard	Desirable	Doubtful
Furnace-lining drying	Oven heaters and special heaters	500 to 1,000	5 to 100	99+	Both	Either	Doutbful
Glass annealing	Furnace elements	900 to 1,300	10 to 100	99+	Both	Either	Doubtful
Glue cooking and heating	Glue cookers and pots	150 to 200	0.1 to 2	99+	Standard	Desirable	Desirgble
Glass melting	Arc furnaces	1,800 to 2,600	25 to 200	95 to 99	Special	Undesirable	Doubtful
Heat treating	Furnaces and equipment	1,400 to 2,000	0.5 to 2,000	99+	Both	Desirable	Desirable
Hat-making machine heating	Cartridge, steel-clad and special	250 to 500	0.5 to 2	99+	Both	Desirable	Doubtful
Ice cutting	Special	500 to 1,000	10 to 100	99+	Special	Undesirable	Doubtful
Ironing-machine heating	Steel-clad heaters	400 to 500	0.5 to 10	99+	Standard	Desirable	Desirable
Ink drying	Steel-clad, special	500 to 1,800 (on elements)	0.5 to 25	99+	Both	Desirable	Desirable
Coil impregnating	Immersion and oven heaters	200 to 270	1 to 75	99+	Standard	Desirable	Desirable
Incubator heating	Steel-clad and special	85 to 100	0.1 to 2.5	99+	Standard	Desirable	Doubtful
Lead-pot heating	Furnace elements	1,400 to 1,800	10 to 100	99+	Both	Desirable	Desirable
Laboratory furnace heating	Furnaces	1,000 to 2,000	0.1 to 10	99+	Standard	Desirable	Desirable
Lithograph drying	Ovens and oven heaters	300 to 550	30 to 250	99+	Standard	Desirable	Desirable
Leather-goods drying	Ovens and steel-clad	100 to 250	0.1 to 100	99+	Standard	Desirable	Doubtful
Liquid heating	Immersion and clamp-on heaters	130 to 212	0.5 to 100	99+	Standard	Desirable	Doubtful
Lumber drying	Ovens and oven heaters	80 to 200	10 to 500	99+	Standard	Desirable	Doubtful
Heat drying	Ovens, heaters, steel-clad	150 to 300	10 to 50	99+	Standard	Desirable	Doubtful
Milk pasteurizing	Immersion and special	160 to 180	50 to 250	99+	Both	Doubtful	Doubtful
Milk evaporating	Immersion and special	180 to 212	50 to 250	99+	Both	Doubtful	Doubtful
Matrix drying	Steel-clad	350 to 550	1 to 20	99+	Standard	Desirable	Desirable
Medical-instrument heating	Standard and special	110 to 210	0.5 to 5	99+	Both	Desirable	Desirable
Molding-machine heating	Cartridge and steel-clad	200 to 300	0.5 to 5	99+	Standard	Desirable	Desirable
Motor and generator warming	Cartridge and steel-clad	150 to 200	1 to 10	99+	Standard	Desirable	Desirable
Oil-tempering-bath heating	Immersion and clamp-on special	450 to 700	1 to 25	99+	Standard	Desirable	Desirable
Oil cracking	Furnace heaters	1,000 to 1,300	25 to 1,000	99+	Both	Doubtful	Doubtful
Oil-well heating	Special heaters	150 to 250	10 to 25	99+	Special	Doubtful	Doubtful
Paint drying	Ovens, oven heaters, steel-clad, etc.	110 to 250	10 to 100	99+	Standard	Desirable	Doubtful
Pipe-line heating	Steel-clad, special	80 to 150	10 to 200	99+	Both	Doubtful	Doubtful
Pitch heating	Immersion heaters, clamp-on and furnace heaters	150 to 350	10 to 50	99+	Both	Doubtful	Doubtful
Restaurant cooking	Ranges, hot-plate, broilers, etc.	350 to 900	1 to 25	99+	Standard	Desirable	Desirable
Rosin heating	Special heaters	150 to 300	0.5 to 2	99+	Special	Doubtful	Doubtful
Roofing-compound heating	Immersion, clamp-on furnace heaters	200 to 450	10 to 100	99+	Standard	Desirable	Desirable
Rubber curing	Ovens, steel-clad	180 to 260	2 to 100	99+	Standard	Desirable	Doubtful
Rubber molding	Cartridge, steel-clad	180 to 260	0.5 to 10	99+	Standard	Desirable	Doubtful
Steam generating	Cartridge, immersion, electrode, induction	212 to 400	1 to 1,000	60 to 99	Both	Doubtful	Doubtful
Steel melting	Arc and induction furnaces	15 to 1,600	C200 to 1,500	50 to 90	Both	Either	Desirable
Solder and babbitt melting	Solder, babbitt pots and furnaces	750 to 950	0.2 to 20	99+	Standard	Desirable	Desirable
Steam sterilizers	Hot plates and heaters	200 to 300	0.2 to 10	99+	Both	Either	Desirable
Shoe-machine heating	Cartridge heaters, steel-clad, etc.	150 to 350	0.1 to 5	99+	Standard	Desirable	Desirable
Street-car heating	Street-car heaters	64 to 80	0.5 to 3	99+	Standard	Desirable	Desirable
Sulphur melting	Furnaces and furnace heaters	.....	25 to 250	99+	Special	Either	Desirable
Sulphur refining	Furnaces and furnace heaters	.....	25 to 250	99+	Special	Either	Desirable
Solder iron heating	Solder irons, furnaces, etc.	500 to 750	0.1 to 2.5	99+	Standard	Desirable	Desirable
Spring tempering	Furnaces, ovens, heaters	750 to 1,000	10 to 250	99+	Standard	Desirable	Desirable
Vulcanizing	Steel-clad and heaters	225 to 275	10 to 100	99+	Standard	Desirable	Doubtful
Water heating	Immersion, clamp-on steel-clad	150 to 200	0.2 to 10	99+	Standard	Desirable	Doubtful
Wax pot	Steel-clad and special	250 to 350	0.2 to 10	99+	Standard	Desirable	Desirable
Wood-veneer-machine heating	Cartridge and steel	150 to 250	0.2 to 10	99+	Standard	Desirable	Doubtful
Wire-temper drawing	Furnace, lead pots, etc.	1,400 to 1,700	10 to 100	99+	Both	Either	Desirable
Wire enameling	Oven and special heaters	650 to 800	10 to 100	99+	Both	Either	Desirable
Wire annealing	Furnaces and furnace heaters	1,200 to 1,400	10 to 100	99+	Both	Either	Desirable

*_Standard_—Apparatus fully developed. _Special_—New apparatus; development charges perhaps involved. _Either_—The applications may be such as to permit the use of standard apparatus or special apparatus. _Desirable_—Good business economically. _Undesirable_—Not good business at the present time. _Doubtful_—May be either desirable or undesirable, depending upon local conditions; not a sufficient amount of installations made to be able to classify it properly.

Digest of Electrical Literature

Hydro-Electric Development and Steam Equipment

Types and Field of Application of House-Service Generators. — W. R. HEROD.—An economical and reliable supply of energy for station auxiliaries under all operating conditions is essential in the modern generating plant, whether the station be that of a large public utility or one supplying power to an industrial plant. With the advent of the house-service generator came notable advances in auxiliary economies, and the various methods of utilizing such units now receive careful attention. The author briefly outlines various types of house-service generator drives and the fields of service to which they are usually applied. It should be realized, however, that local conditions influence the selection primarily, and that changing conditions in a plant may make advantageous the changing of the method of house-service generator drive from time to time. A chart included with this article summarizes the usual house service generator drives and their conditions of operation.—*General Electric Review*, August, 1924.

Water-Cooled Furnaces. — W. E. CALDWELL.—When the fifth unit was installed in the Hell Gate station of the United Electric Light & Power Company three new boilers were also added which, while being of the same type as installed in the original installation, differed somewhat, especially as regards furnace design, baffling and superheater location. The most pronounced departure from the original practice was the installation of side-wall cooling tubes in the furnaces. The sidewalls are made of 4-in. tubes with overlapping fins. Furnace deterioration has been greatly reduced and the combined efficiency has run as high as 92.7 per cent. Recent tests conducted on these boilers are summarized.—*Power*, September 2, 1924.

Generation, Control, Switching and Protection

Automatic Time Switch.—F. CELLERIER.—A number of arrangements have been developed by means of which a contact is automatically opened after it has been closed a certain predetermined time. In most of these devices the variable time element is introduced mechanically by some kind of clockwork or hydraulically by a dashpot. Such apparatus, the author claims, are very delicate, require careful setting, have independable contacts and are not short-circuit-proof. A time switch is described wherein the delay is actuated by the expansion of an eletcrically heated volume of confined air. The increasing air volume inflates a bellows, which in turn acts upon a contact, disconnecting the heating resistance. The following air contraction takes place through an adjustable orifice and can be retarded from one second to several hours. The main power contact is made and broken on mercury contacts inclosed within a steel tube filled with an inert gas. These switches are in use in Paris as silent traffic policemen and have for more than a year operated 15,000 times daily. They are designed for 5 amp. at 110 volts.—*Revue Générale de l'Electricité*, Aug. 30, 1924.

Lightning Arresters. — C. E. BENNETT. — The electrolyte-tube type of lightning arrester is described and its discharge characteristics are explained. The author shows that this lightning arrester is a high-resistance device and slow in action as compared with other types, but that it can be set for 25 per cent excess voltage and therefore will start to discharge at a low rise in potential. A variation of this type of arrester is shown which consists of a string of small units to be hung as a line. Each unit is sealed and half filled with electrolyte with a pierced partition in the center, so that the interruption of dynamic current results from the passage of current to the small pencils of liquid in the partition.—*Journal of A. I. E.*, September, 1924.

Transmission, Substations and Distribution

Transmission and Distribution Hardware.—M. BUCOV.—A large variety of hardware parts are required to connect cables, insulators, guy wires, etc., on overhead high-voltage lines. These parts have previously been made of either galvanized cast iron, cast bronze or cast aluminum. The mechanical strength, and consequently the reliability, of these cast parts was frequently doubtful, on account of the almost unavoidable internal blowholes. A large German company has therefore introduced recently a complete line of such hardware made of pressed brass or aluminum. The mechanical features of this new line material can best be seen from the following tabulation:

	Strength in Kg. per Sq. Mm.	Elongation, Per Cent
Cast bronze	15-16	4-10
Pressed brass	40	25
Cast aluminum	6	10
Pressed aluminum	10	25

The pressed-aluminum parts cost about 10 per cent more than cast iron, but this amount is fully saved by savings on freight and the scrap value of old parts. A great number of examples of these new accessories are given.—*Elektrotechnik und Maschinenbau*, Aug. 3, 1924.

Oil-Circuit-Breaker Investigation.—J. D. HILLIARD.—The author describes investigations made on oil-circuit breakers with special testing equipment and gives the results so far obtained. In his opinion, break distances should be based on the worst possible conditions, such as a dead short circuit on an ungrounded system. The interrupting capacity of a breaker depends on the speed of break and on the quantity of gas generated and the speed of gas generation. The head of oil in a breaker was found to affect its performance appreciably, presenting a very important consideration. Linings have been found necessary as a result of these tests.—*Journal of A. I. E. E.*, September, 1924.

Units, Measurements and Instruments

Hysteresis Character of Corona Formation.—H. J. RYAN and H. H. HENLINE.—Sixty-cycle corona in all ordinary circumstances develops the character of a gas dielectric hysteresis. The values of crest voltages are controlling in respect to losses by corona formation. Critical voltage can have a definite value only when the brush discharge pattern in corona formation is stable. The rational corona loss-voltage relation as given in a formula in the paper is correct only with limits of full corona formation where the capacitance value and brush pattern remain fixed. Local corona loss varying from 0 kw. to 8 kw. per mile depends upon too many variable factors to permit of calculation without the use of knowledge to be obtained only through a large amount of further study by measurements.—*Journal of A. I. E. E.*, September, 1924.

Strength and Related Properties of Metals and Wood.—This circular of 204 pages contains the values for tensile, compressive and shearing strengths, ductility, modulus of elasticity and other related properties of pure metals and their alloys and of wood. In addition to these the properties of metals at elevated temperatures, their fatigue and impact properties and the effect of heat treatment and cold working are given. Other properties and uses of less commonly used metals are described briefly. Graphical representation is used in many cases to show the change of the properties of a material with changing conditions. References to the sources are given for all values in this circular.—*Circular No.* 101 *of the Bureau of Standards.*

Factors Affecting Electrical Tuning Forks.—A. B. WOOD.—A brief outline is given of the various factors affecting the frequency of electrically maintained tuning forks. The importance of damping is discussed, and it is shown that the direct effect on frequency is negligible, although damping serves as an indicator of other factors which affect frequency. It is shown in a particular case that the damping of a perfectly balanced fork is about 90 per cent of that of the same fork with the prongs badly out of balance. The variation of damping with amplitude, with the load on the base of the fork, and the amount due to spring contacts are also examined. It is shown also that the weight of the base of the fork has an important influence on the frequency.—*Journal of Scientific Instruments*, August, 1924.

Motors and Control

Changing a Steel-Mill Main-Roll Motor Drive.—A. W. MCAULY.—The electric drive of a steel mill was found upon installation to be too small to run the mill at its greatest capacity. The author describes the changes and rearrangements found necessary to obtain the required capacity. This experience illustrates the possibilities of changing the characteristics of electrical machinery to meet operating conditions when they are different from those for which the machinery was designed.—*Industrial Engineer*, September, 1924.

Electricity's Contribution to the Steel Industry.—K. A. PAULY.—A brief outline of the processes involved in the production of steel is followed by a discussion of the characteristics of the various rolling mills and the types of motors used to drive them. Considerations affecting the choice of frequency are also discussed. The author believes that the greatest contribution of electricity to the steel industry is in providing a means for economically using the waste gases from blast furnaces. He points out the importance, as a conservation measure, of the utilization of blast-furnace gas and other sources of by-product power.—*Journal of A. I. E. E.*, September, 1924.

Change-Speed Induction Motors.—C. W. KINCAID.—The various methods of winding induction motors for different speeds, including the three-phase, series-star low-speed, parallel-star high-speed, three-phase, parallel-star low-speed, series-star high-speed and others, are described in detail. Distribution factors, chord factors, details for rotor windings are discussed.—*Electric Journal*, August, 1924.

Heat Applications and Material Handling

Heat Shrinking of Rotor Disks.—E. ROSENBERG.—The rotor of a 13,000-kva., three-phase generator, consisting of five disks of 2 tons each and two end disks weighing 1,200 lb. each, was assembled by heating the seven disks electrically and shrinking them upon the rotor shaft. A large butt-joint transformer core was used for this purpose, over one leg of which one of the disks at a time was threaded. Six twin-section circular coils, arranged on the same leg above and below the rotor disk, served as primary winding. Calculations called for a current of about 9,000 amp. to reach the desired 250 deg. C within two and a half hours, or about 33 kw. in the primary winding. The complete process of assembling the rotor required less than twenty hours. Although no precautions were taken to retain radiated heat from the rings during heating, a thermal efficiency of 63 per cent was reached.—*Elektrotechnische Zeitschrift*, July 24, 1924, and *Elektrotechnik und Maschinenbau*, July 27, 1924.

Combining the Retort Process with Electric Smelting of Zinc Ores.—E. W. HALE.—The duplex process for smelting zinc ores described combines the present fire-heated retorting of zinc ores with a final electric smelting and recovers the zinc, lead, copper, gold and silver in the one completed treatment. Its primary principle is a prereduction of the charge at a low temperature—1,150 deg. C. in the present retort furnace—during which 50 per cent to 75 per cent of the zinc is obtained before the ore enters the electric furnace for the extraction of the remainder of the zinc and whatever other metals are present. The heated and partly de-zinced charge is removed from the retorts to the electric furnace in successive charges, the electric furnace being continuously at working temperature. In the electric furnace metals other than the zinc are also recovered. It is claimed that the zinc recovery is 5 per cent higher than that which is obtained with the present methods. — *Engineering and Mining Journal-Press*, Sept. 6, 1924.

Traction

Recent Developments in Electric Locomotives.—N. W. STORER.—Tabulated data of types, dimensions, weights, capacities, etc., for a number of recent designs of locomotives are given in this paper. The reasons for the several types shown are explained and the designs discussed. The conclusion drawn is that there is a tendency toward the maximum axle loading with gear and side-rod drive for heavy freight service, and toward the individual drive with spring-supported motors for high-speed passenger locomotives. For direct-current locomotives with lighter axle loading the axle-hung direct-geared motor has the field.—*Mechanical Engineering*, September, 1924.

Large French Rectifier Installation. W. WALTY. — A 70-mile stretch of a southern French main road was electrified in 1914 to operate on 12,000-volt, 16⅔-cycle, single-phase current. A 60,000-volt feeder line supplied four transformer substations along the road. In 1920 French federal authorities approved and standardized for the whole of France a 1,500-volt direct-current traction system, so that it became necessary to remodel the road just referred to. The relatively small substation buildings, which had to be changed from pure transformer stations into current-converting stations, would not have permitted the installation of rotating machinery without additions, so that mercury-arc rectifiers had to be chosen. Including a new (fifth) substation, a total capacity of 19,200 kw. has thus been installed in rectifiers, comprising thirty-two units of 600 kw. each. This, it is claimed, is the largest existing rectifier installation for railroad purposes. The author goes into great detail, describing the complete equipment of these stations. In addition, very complete test results were given concerning transformers and rectifiers, as arrived at when the stations were taken over by the railroad. An outstanding accomplishment is the exceedingly high efficiency of the rectifiers at low load, dropping from 95.1 per cent at full load to as high as 92 per cent at quarter load. The rectifiers will stand 50 per cent overload for three hours and 200 per cent for five minutes. A part of these tests was ten dead short circuits at intervals of one minute.—*Brown-Boveri Mitteilungen*, September, 1924.

Electrophysics, Electrochemistry and Batteries

Modern Practice in Electrolytic Chlorine-Caustic Production.—H. J. PAYNE.—The chlorine-producing capacity of the United States has been shown to be nearly twice that required to meet demand. Such a condition naturally has a stimulating effect upon operating methods—methods that in the past have been carefully investigated and highly developed by master engineers. Price wars among large chlorine and bleach producers have placed concerns maintaining independent electrolytic plants in a quandary. The Eastern Electrochemical Company, Bangor, Me., has operated steadily in the face of these adverse conditions and has established precedents in its application of scientific principles to practical technology.—*Chemical and Metallurgical Engineering*, September 1, 1924.

Telegraphy, Telephony, Radio and Signals

Four-Electrode Tube and Its Circuit.—H. DE A. DONISTHORPE.—The paper deals with the early forms of quadrodes or four-electrode tubes and leads up to a complete description of the Marconi type of quadrode and the attendant amplifier circuit. This circuit utilizes one tube and effects a one-stage radio frequency, a rectification and a one-stage audio frequency. Information is detailed as to the practical experience obtained with this amplifier and quadrode, this particular combination now being in commercial use.—*Proceedings of the Institute of Radio Engineers*, August, 1924.

Transmission Maintenance of Telephone Systems.—P. E. ERICKSON and R. A. MACK.—In the first part of the paper the authors deal with the broad aspects of modern telephone transmission maintenance, the economic justification for good maintenance and the general lines upon which it should be carried out. The second part gives the theoretical considerations leading up to the development of a series of testing instruments by means of which transmission losses in any part of the telephone system can easily be measured. A brief description of the instruments and their use is also given.—*Journal of the Institution of Electrical Engineers (England)*, August, 1924.

Limit of Regeneration.—N. C. LITTLE.—It is shown that at the limit of regeneration the relative magnitude of the signal received in the plate circuit to that impressed on the grid is inversely proportional to the latter. This inverse signal-strength law is explained in terms of the characteristics of the tube. Two methods of determining the effective resistance of a regenerative system are outlined. Practical suggestions are offered for the design of regenerative systems. — *Proceedings of Institute of Radio Engineers*, August, 1924.

News of the Industry

Middle West Companies Are Merged

United Light & Power, Continental Gas & Electric and Columbus Railway, Power & Light, with Subsidiaries, Pool Their Interests

ANNOUNCEMENT has just been made of one of the largest consolidations of electric light and power companies in this era of consolidation. The merger takes in the United Light & Power Company, which, with headquarters in Grand Rapids, Mich., owns important electric light and power properties in Iowa, Illinois and Indiana, an electric railway in Michigan and gas properties in Chattanooga, Tenn., and elsewhere; the Columbus (Ohio) Railway, Power & Light Company, and the Continental Gas & Electric Corporation with its subsidiaries, chief among which are the Kansas City Power & Light Company and the Lincoln Gas & Electric Light Company.

These newly consolidated companies own public utilities in eight Central West states—Iowa, Illinois, Indiana, Michigan, Missouri, Kansas, Nebraska and Ohio. Among the larger cities where they have light and power plants are Kansas City, Mo.; Columbus, Ohio; Lincoln, Neb.; Davenport, Fort Dodge, Mason City, Muscatine and Iowa City, Iowa; Rock Island, Moline and East Moline, Ill., and Laporte, Ind. The companies serve a total population of about 1,750,000 and have a combined normal generating capacity of 340,000 kw. Their total gross revenues are put at about $34,000,000 annually.

The announcement says that the consolidation "brings together a number of men who have long been associated with the successful management and operation of public service enterprises in the Middle West, and important financial interests." The officers of the consolidated company will be C. S. Eaton of Cleveland, chairman of the board; Frank T. Hulswit of Chicago, president; Richard Schaddelee of Grand Rapids, Rufus E. Lee of Omaha, J. Denman of Davenport, William Chamberlain of Cedar Rapids and L. H. Heinke of Grand Rapids, vice-presidents. Joseph F. Porter, president and general manager of the Kansas City Power & Light Company, will be a director with Landon K. Thorne, of Bonbright & Company, investment bankers of New York; Burton A. Howe and Warren H. Snow of Grand Rapids, William Butterworth of Moline, Glenn M. Averill of Cedar Rapids, Charles H. McNider of Mason City and Thomas Jones of Cleveland. Present operating personnel will remain in charge of the individual companies.

The announcement revealed that the United Light & Power Company has recently acquired more than 75 per cent of the outstanding common capital stock of the Continental company. The United in the near future will offer to acquire, in exchange for its own securities, all of the remaining outstanding common stock of the Continental. The United Light & Power Company's gross earnings have increased from less than $6,000,000 in 1912 to more than $12,500,000 this year.

General Squier Will Appeal from Patent Decision

Major-General George O. Squier has announced that he will appeal against the decision of the United States Court in New York declaring that his "wired-wireless" devices are not under patent-law protection because they were dedicated to public use by the inventor. (See ELECTRICAL WORLD for September 6, page 479). General Squier says that he will carry the case to the United States Supreme Court if necessary in order to have a definitive finding on the question at issue, which is, the General says, whether a patent that by the terms of the application "may be used by the government or any of its officers or employees in the prosecution of the work of the government or by any other person" can be used by private manufacturers, or whether the words "any other person" mean by implication any other person prosecuting government work. If the decision shall be against him, General Squier contends that "the bottom will fall out of inventive research in the government service."

Home Light Contests Exceed All Expectations

Two thousand eight hundred and thirty-eight communities, with a population totaling over forty-two million, have now expressed their intention of holding home-lighting contests, according to reports received up to Thursday of this week by the Lighting Educational Committee through its regional directors. This number is nearly double the figure of 1,500 communities which was set as the maximum number that would participate when the home-lighting contest was planned. Even the figure of nearly three thousand is not complete, as a number of communities which will hold contests have not yet officially notified the headquarters of the committee of their intention.

The forty-two million population which lies in these communities represents 65 per cent of the population which is served by electricity. People living on farms or in towns which have no lighting service represent a population of thirty-one million people which cannot be reached by this activity.

Reports have been received from nearly one hundred communities that the school authorities have indorsed the contest.

Milwaukee Contract Terms

Service at Cost in All Departments of Railway and Light Company with Purchase Option to City

EVENTUAL ownership of the property of the Milwaukee Electric Railway & Light Company in the city of Milwaukee by the city is the aim of a new contract between the company and the city the terms of which were made public this week. The measure, as noted in previous issues, has been in preparation over a long period of time by a committee of which Fred S. Hunt has been chairman. The next move is the submission of the contract to the Council. If the way can be paved there, the measure will probably be submitted to the voters in April and, if approved by them and the Railroad Commission, may become effective on July 1, 1925.

The new grant is designed to provide service at cost in all departments of the company with an option to the city to purchase the undertaking, management of the property meanwhile to remain in private hands, with the earning power to remain unimpaired. The city will not guarantee earnings, and no charge against general taxpayers is involved. Rate schedules in effect when the contract is executed will remain in force until changed in the manner the contract provides. Among other provisions of the new grant are the following:

Contract to run in successive periods of ten years with an option by the city to purchase by giving six months' written notice.

Company for first year given a return of 7.7 per cent a year on its railway investment and 8 per cent upon the electric light and heating utility, excess to go to the city. Return thereafter to be changed according to the index interest rate providing for 7.7 per cent to the company on a 5.7 per cent index and varying with the changes in the index.

City to pile up an interest in the company through the so-called "city equity account," built up by loans to the company; through excess earnings which accrue to the city and through taking "municipal mortgage bonds" on the company property.

City to have control over service and over extensions of service during the period of the contract, with certain restrictions.

Option to purchase to include the company's heating, lighting and railway property in the entire metropolitan district.

On the important matter of value the ordinance may be said to provide for the allowance of a figure of about $51,500,000. The report says that while a definite value of the company's property must necessarily be related to a certain date, since the value is constantly changing, the value of the fixed property of the company in the contract area, or metropolitan district, was $39,435,334, as of January 1, 1921, as audited. To this figure is added $12,027,640 for additions and improvements in the contract area since that date.

Griffith Stirs Audience

Urges Greater Civic Activity—American Institutions Are at Stake and Need Help of Utility Men

FRANKLIN T. GRIFFITH, president of the N. E. L. A., speaking on September 25 at the annual banquet of the Great Lakes Division at French Lick, Ind., pleaded in a very effective manner for a more active interest and participation in civic and political affairs on the part of engineers and utility executives. Trustees of the public to furnish a necessary utility service, he said, these men are also trustees of the institutions giving this service. Present-day political unrest is in part evidenced by the ignorant assumption on the part of many that the corporation which makes possible the big business of today is a soulless enterprise. It is the duty of utility men and women to spread the idea of what a corporation really is—merely an aggregation of human people and their property to perform a useful human service. Executives and engineers and all other utility people must constantly strive to increase the knowledge of the public with reference to sound economic principles of business—and thus of utility—operation, and also to impress upon the public the dangers of following unsound principles. Of all people, he held, those in the utility business have the most right and the greatest obligation to do this work.

Urges Political Activity

Saying that he was speaking personally, and not for the industry, but to it, President Griffith said that he thought the people of the utility industry should take an active part in politics, since they enjoy a more intimate association with the public and consequently a greater knowledge of the public and its attitude than is possessed by those in any other business. In his estimation the largest part of those who might this fall vote for a vague plan of relief from human laws would do so because of ignorance of the real issues involved. They do not know, he said, that what they will be encouraging is the actual destruction of the principles upon which the United States was founded and on which the American people have built their success and happiness. It is right at home that this ignorance exists. For example, he said, half of the seven thousand employees of one company, he found on investigation, hold views diametrically opposite to those which he had been raised to consider sound and which he believed to be those most necessary to the continued successful development of the country. It is this condition which made him urge that each executive in the industry should examine into his own home conditions, if he would be most true to himself, his industry and his country.

"What I want to say, stated in another way," said Mr. Griffith, "is that we must get ourselves and others over the idea that it is wrong for utility men to be active in politics. We urge every one to vote—yet every time a utility official votes or particularly exercises his right and duty in politics he is criticised. This is wrong—politics is merely public business, and we are continually in a most important public business. Utility men can do their industry no harm by admitting and working openly for the ideas and principles which they believe to be sound."

Martin J. Insull, chairman of the public policy committee, N. E. L. A., also spoke of the necessity of aggressive work along these lines.

Women's Work Again to the Fore

Great Lakes Convention Convinced of Its Efficacy—Excellent Commercial, Managerial and Engineering Papers Are Discussed at French Lick

WOMEN'S work in public utilities, as reflected and demonstrated by the four excellent addresses given by women actually engaged in this activity, was the part of the convention program of the Great Lakes Division, N. E. L. A., that aroused most comment last week, and the convention showed itself in complete accord with the plan of having women fit themselves to help utility companies develop good public relations. The convention met at French Lick, Ind., as reported previously, on September 25-27. There was an enthusiastic attendance of 550 from the four states bordering on Lake Michigan. The morning sessions were given over to reports and technical papers, while the afternoons were left open for entertainment and recreation, notably golf.

Following Marshall E. Sampsell's presidential address (see ELECTRICAL WORLD, September 27, page 700), Mrs. P. W. Evans, Interstate Public Service Company, Indianapolis, chairman of the women's public information committee, reviewed the year's work. She estimated that more than two thousand women employees had attended educational meetings within the division during the year. She asked executives to allow utility women to become members of local clubs and organizations on the same basis as the men, that study courses be given to inform women employees about the essentials of utility operation and also that more group meetings be held.

Capitalizing "Woman Power"

Miss May S. Fletemeyer, Northern Indiana Gas & Electric Company, Hammond, dealt effectively with the value of this work to the individual woman employee in giving her a broader viewpoint, and Miss Ethel M. Westenhaver, Beloit, Wis., declared that, a way having been found to capitalize on "woman power" within the industry, it will not be the women's fault if the truth about electrical utilities is not soon better known. A vivid picture of handling customer acquaintanceship was painted by Miss Mabel W. Miller, East St. Louis Light & Power Company. Women employees are better fitted than men, she said, to represent the utility in personal calls on customers.

Carl D. Jackson, New York, discussed the relation between the legal profession and efficient utility operation. A symposium on utility security selling was opened by Fred H. Scheel, Utility Securities Company, Chicago, who discussed ethics and sales methods. Paul Young, Illinois Power & Light Company, told how two utilities had floated a security issue in different localities. Contact after purchase was considered by F. W. Hoover, Consumers Power Company, Jackson, Mich., a vital factor in keeping customers interested.

Reduction in Insurance Rates

Friday morning's session was opened by a report on electric insurance presented by C. B. Scott, Chicago. As a result of national activities, a reduction in public liability insurance rates from $4.05 to $2.50 per $100 is now available, Mr. Scott said.

R. F. Schuchardt, Chicago, referring to his report on the Great Lakes Power Survey issued last May, told how preliminary estimates for the territory indicated that in 1950 generating capacity will be trebled over present capacity.

Accurate control of materials was discussed by H. W. Duncan, Northern Indiana Gas & Electric Company. This control resolves itself into four divisions — complete inventories, central control, correct accounting and coordination with purchasing, operating and sales departments. Mr. Duncan favored the use of duplicate tags as the only accurate way of securing a complete count of material on hand. For central control one person should be held responsible.

A refutation of the idea that electric industrial heating costs are high was made by C. H. Stevenson, Commonwealth Edison Company, Chicago, when he compared fuel-heating costs with electricity. Too often, he said, the comparisons have been primarily based on energy costs and not on the total cost of operation—the true criterion. Mr. Stevenson said that while the thermal efficiency of gas furnaces averaged only 20 per cent, the efficiency of electric operation rose to 80 per cent.

Progress reports in the four states on the better home-lighting contest followed a brief review on the national work by Chairman J. E. Davidson. For the seventeen million people living in Wisconsin, Illinois, Indiana and Michigan half the organization work is completed, according to J. F. Gilchrist, regional director.

Reasons why public utilities should advertise were well presented by Donald Mackie, Consumers Power Company.

Electric Cargo Transportation

A new era in city cargo transportation with an extended use of electric trucks was prophesied by Robert L. Fitzgerald, Indiana Service Corporation, Fort Wayne. Mr. Fitzgerald thought that if utility operating syndicates can be convinced of the possibili-

ties of a cargo transportation utility sufficiently to finance and organize it, it will immediately open up a field for electric motor vehicles in their proper place.

Dr. E. A. White, director of the Committee on the Relation of Electricity to Agriculture, spoke on rural service.

Three high-class engineering papers were presented at Saturday's session. H. F. Eddy dealt with the reasons for the design of the 100,000-kw. Zilwaukee plant of the Consumers Power Company, which is expected to produce energy at 13,000 B.t.u. per kilowatt-hour; Harold Cole, Detroit Edison Company, discussed the economic loading of distribution transformers on lighting loads only, and a paper on transmission tower engineering and construction was read by F. E. Andrews, Public Service Company of Northern Illinois.

Large Gathering at West Baden, Ind.

President of Association of Electragists International Makes Plea for a Stronger Body of Retailers and Contractors—Progress Toward Uniform Code

GRATIFYING progress in the promotion of inspection uniformly in a large number of cities and a serious consideration of the problems of distributors as they affect the electrical contractor-dealer were the keynotes of the twenty-fourth annual convention of the Association of Electragists International, held this week at the West Baden Springs Hotel, West Baden, Ind. It was the largest national gathering of contractor and dealers seen for many years, and an elaborate exhibition participated in by about fifty manufacturers was a feature of the meeting.

President James R. Strong in his opening address discussed the present status of organization in the electrical industry and the vital need for a larger membership and stronger association of retailers and contractors. He stressed the importance to the wiring contractor of the development of higher standards in the sale of house wiring through the installation of more adequate facilities for the use of complete electrical equipment and the encouragement of more uniform inspection throughout the country in conformance with the standardized codes. He predicted even keener competition between retailers as prices are brought into line and urged a continued effort to improve still further present methods of distributing and retailing electrical merchandise. The association, he says, has gained materially in membership through the year and is in sound financial condition.

A. Penn Benton, Kansas City, reported that local code committees have now been established in 102 cities operating in co-operation with the association, with a membership embracing a local contractor, the municipal inspector, the insurance inspector and a representative of the Central States. These committees are assisting toward the uniform interpretation of the code and the maintenance of a high inspection standard. He reported also that seventeen cities have now adopted the all-metal standard of construction.

R. U. E. Moore, representing the Electrical Manufacturers' Council, presented for the approval of the association a model form of ordinance which has been prepared by the electrical manufacturers as a guide for use in the preparation of ordinances by cities desiring to institute municipal inspection to insure the recognition of the American standard. This model ordinance received the indorsement of the association with the recommendation of some minor changes.

William L. Goodwin, vice-president Society for Electrical Development, presented the "Red Seal" plan as a practical influence for the improvement of the standard of adequacy in house wiring, and it received the unanimous indorsement of the association.

Wednesday's session was given up to the discussion of distribution and merchandising policies. W. Creighton Peet presented the report of the trade policy committee, embracing a study of present practices; W. R. Hurstein, Electric Supply Company, Memphis, contributed the jobbers' viewpoint; George L. Purvis, Hurley Machine Company, Chicago, discussed the distribution of appliances, and Albert Wahle, Albert Wahle Company, New York, presented the viewpoint of the fixture manufacturers. An interesting innovation in the program was a series of business classes on practical problems of the contractor-dealer. The program for Thursday and Friday included papers on handling the "big job" motor repairs business, old-house wiring on a large scale, retailing radio appliances and a presentation of the Lighting Educational Committee's better home-lighting undertaking.

National Safety Council Has Successful Congress

The thirteenth annual congress of the National Safety Council, held at Louisville this week, was highly successful in attendance, exhibits and enthusiasm. The Public Utilities Section met on Wednesday in joint session with the Electric Railway Section. Most of the papers were in the traffic and transportation field, but Homer Niesz, Commonwealth Edison Company, Chicago, talked on "Safety in the Substation," explaining methods of employing and training men and enforcing rules. He discussed safety equipment, such as gas masks, leather coats, helmets, etc., advantageous in making rapid repairs after blow-outs and similar accidents. The paper gave rise to a long discussion.

At another session of the Public Utilities Section C. E. Greenwood, superintendent appliance department, Boston Edison company, gave an address on "Selection and Safe Installation of Electric Appliances."

Applications for a Raquette Regulating District Dropped

A development in the long fight over water storage and power production in the Adirondack region of New York State was reached recently by the withdrawal of the application made under the water-storage law for the creation of a Raquette River Regulating District. Such an application had been filed jointly by the Snell Power Company, the St. Lawrence Transmission Company, the Hannawa Falls Water Power Company, the Potsdam Electric Light & Power Company and by the International and other paper-manufacturing companies and the Sherman Lumber Company. It had aroused intense opposition from many property owners and others interested in the preservation of scenic beauties in the Adirondack park region, and particularly from the Saranac Lake Chamber of Commerce. The contention that such regulating reservoirs would destroy the scenic attractiveness of the region or induce unhealthful conditions was vigorously denied by officials of the Power Corporation of New York, which through its subsidiary companies was largely interested in the plans. (See ELECTRICAL WORLD, September 8, 1923, page 504.) The dispute played a part in the fight over the Ferris water-power amendment to the state constitution, which was decisively defeated at the polls last November.

Public Ownership to Bring Electrical Millennium

When it comes to roseate promises, the new Progressive party of Senator Robert M. La Follette is abundantly able to hold its own with its older and more experienced rivals. Some of its most attractive promises are based on the public ownership and development of water power that is to follow triumph at the polls. Charging that the "'Electric Power Trust,' composed of eighty-five public service corporations and controlling 68 per cent of the total public service power in the United States," is "stifling development in this field by monopoly control and excessive charges," the Progressives propose "to maintain public ownership of the nation's water power and to develop a great national superpower system to furnish light and power at cost to the people."

"Such a program," their manifesto continues, "will cut the physical toil and burdens of the housekeeper in half, will greatly multiply the productive powers of the industries of the nation and develop hundreds of new industries that were never possible before, will reduce the cost of transportation and double, if not treble, carrying capacity, and will provide the farmer with electric current for 35 cents a day equal to the labor of five men and a four-horse team. It will eliminate the smoke nuisance in cities; it will irrigate and reclaim millions of acres of arid lands where citizens may find employment and build homes; it will stop destructive floods and aid navigation, and by thus expanding and enlarging the industrial, agricultural and

domestic life of the nation, open a new era of progress and general prosperity."

In proof of these prophecies the party's spokesmen cite rates in Springfield, Ill.; Tacoma, Wash., and the Province of Ontario.

N. E. L. A. Meetings

Executive Committee and Other Representatives of Body Have Busy Sessions in Chicago

WITH the best attendance seen in recent years, including the national officers, the members at large, the national section chairmen, the presidents of the geographic divisions and a score of invited representatives of the industry, the executive committee of the National Electric Light Association met in the Commonwealth Edison Building, Chicago, last week. A brief impromptu address was made by President Franklin T. Griffith, stressing his sense of the public duty which the executives of light and power companies owe to their community, their state and the nation at large. Reports on activities under way and plans for the coming month were outlined by the president and Managing Director Aylesworth, and the budget was approved. Dr. E. A. White and G. C. Neff reported on rural service progress, F. R. Jenkins on education of employees, and the representatives of the geographic divisions on their respective fields.

W. E. Creed, president of the Pacific Gas & Electric Company, San Francisco, talked on political conditions in California and expressed confidence that the water and power act would again be defeated at the referendum next November. The somewhat similar situation in the State of Washington brought about by the referendum on the Bone bill to permit municipalities to give service outside their own limits and to condemn competing private plants was discussed by W. H. McGrath, vice-president Puget Sound Power & Light Company, Seattle, and G. W. Talbot, president Pacific Power & Light Company, Portland, Ore., in which state also public ownership advocates are active, was a third speaker from the Pacific Coast.

National Vice-president J. E. Davidson outlined the work done so far by the Lighting Educational Committee, of which he is chairman, and said that the campaign would reach fifty million people. Others who addressed the committee were Gerard Swope, president of the General Electric Company, and E. M. Herr, president of the Westinghouse Electric & Manufacturing Company. Reports were made by W. Paxton Little, W. R. Putnam and H. P. Liversidge, chairmen respectively of the Accounting, Commercial and Technical Sections. James R. Strong, president of the Association of Electragists International, offered the assistance of that body in furthering customer ownership. Mr. Strong also spoke upon the question of proper distribution of appliances and the necessity for a reasonable profit being made by contractors and dealers and suggested that this entire matter be taken up by the Joint Committee for Business Development.

The question of whether the 1925 convention of the association shall be held in Portland or San Francisco was left for decision to the president and vice-presidents, definite announcement to be made in ninety days.

PUBLIC RELATIONS SECTION

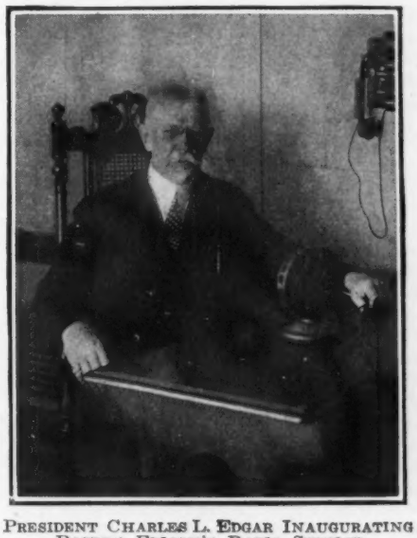
Meeting on the day before the national executive committee, the executive committee of the Public Relations Section also canvassed the political situation in its relation to public utilities. Chairman M. S. Sloan outlined specific plans for the administrative year, calling attention to the completion of the "Employees' Manual." A committee, consisting of T. W. Martin, P. S. Arkwright and L. B. Herrington, was appointed to make any desirable revisions in this work, of which 32,000 copies have so far been distributed.

Plans of the advertising survey committee were reported by J. B. Groce, its chairman. The committee will distribute an illustrated booklet on "goodwill advertising."

Chairman H. C. Abell reported upon the activities of the Information Bureau organizations committee in endeavoring to organize committees in the few remaining states which are not organized and also in maintaining interest in the committees already functioning. He announced that plans for the organization of a bureau covering three states are well under way.

Boston Edison Installs Radio Broadcasting Service

ON MONDAY evening of this week the new 303-meter, 500-watt radio broadcasting station (WEEI) of the Edison Electric Illuminating Company of Boston began operation with a dedicatory address by President Charles L. Edgar in which he emphasized the desire of the company's three thousand employees to render efficient and friendly service to the public. The station will be used commercially besides serving as the "voice of the Boston Edison" to its customers and the public at large. Varied programs will be broadcast.



PRESIDENT CHARLES L. EDGAR INAUGURATING BOSTON EDISON'S RADIO SERVICE

State-Wide Regulation

Investment Bankers' Committee Still Firm for Its Maintenance and Extension

REGULATION of public utilities by state commissions was again unqualifiedly indorsed by the public service securities committee of the Investment Bankers' Association in its report to the annual convention of that body, held at Cleveland last week. The desirability of utility issues as a safe medium for investing funds was recognized by the committee in the introductory paragraph of its report as follows:

"In view of the increased popularity of public utility securities, especially noticeable this year, it is not today of prime importance to discuss methods of improving the acceptability of such securities. Investors generally recognize the inherent soundness of the public utility business. Essentially this condition has been brought about by the industry itself giving a frank and open story of its business and, in part, by its selling securities direct to the consumer. Besides this, the state regulatory commission and court decisions have had the effect of assisting the industry in adjusting itself to postwar conditions as well as protecting the business from malicious attack, too often of political origin."

After quoting from former reports its previous recommendations on regulation, the committee continues:

"State-wide regulation must necessarily be administered in a broad and judicial manner in the interests of the public served, as well as of the investor. This association has pointed out that the interests of both are identical. However, we are far from being unaware that many, including self-seeking politicians, would have the public believe otherwise. The point to be emphasized is that investors are quick to discern the unwarranted nature of attacks on public utilities and unfair or unwise treatment in the administration of laws. Where any of these conditions exist, investors express disapproval either by withholding funds or demanding rates of interest burdensome alike to the industry and to the public served. In the great expansion of the industry which is taking place there is keen competition for investment funds. Investors, therefore, can and actually do pick and choose their investments with discretion, favoring to a marked degree investments in those properties which are protected best by scientific regulation rather than properties which are subject to the whims and fancies of state or local legislative bodies or executive officials.

"In a consideration of this aspect of regulation, we are continually reminded of the fact that more development takes place and rates and services are best in those states where statewide regulation has not been subject to attack. There we find, too, strong support of state regulation on the part of the public. Such results are obtained only when legislatures appropriate adequate funds for administration and commissions are of proper caliber for their tasks."

The committee lists the following

states as having been for the present eliminated from its studies largely because there does not seem to be any immediate need for comprehensive changes in their laws governing utility regulation: Alabama, Arizona, California, District of Columbia, Georgia, Idaho, Illinois, Kansas, Kentucky, Maine, Maryland, Massachusetts, Michigan, Minnesota, Missouri, Montana, Nevada, New Hampshire, New Jersey, New Mexico, New York, North Dakota, Ohio, Tennessee, Utah, Vermont and Wisconsin. It recommends that in Florida, Mississippi, Nevada and Texas the laws be broadened to provide for the state-wide regulation of all public utilities, instead of the restricted sphere now filled by the respective commissions in those states. Specific recommendations not affecting electric light and power companies are made for Indiana and Virginia.

The district groups of the association are again urged to exert efforts to accomplish sound accounting on the part of municipalities which own public utilities, and attention is once more directed to the principles, of vital interest to members of the association involved in the water-power development bill concerning the Great Falls of the Potomac which is now before the United States Congress.

Henry C. Olcott of the Continental and Commercial Trust and Savings Bank was appointed chairman of the public service securities committee for the ensuing year.

Visiting European Engineers Honored at New York

An informal luncheon was given on Friday, September 26, by the presidents and governing boards of the four founder engineering societies at the Engineers' Club, New York, in honor of Sir Charles Morgan, president of the Institution of Civil Engineers; Sir Charles A. Parsons, Senator Luigi Luiggi, president of the Italian Society of Engineers, and William H. Patchell, president of the (British) Institution of Mechanical Engineers. More than eighty members and other engineers were present to meet the distinguished guests, who came to this country to attend the sessions of the recent centenary celebration of the Franklin Institute, Philadelphia.

Sir Charles Morgan and Mr. Patchell were unfortunately unable to be present, but Sir Charles Parsons and Senator Luiggi responded to the addresses of welcome. Sir Charles Parsons thought that further steam installations would meet the major needs of electrical development for many years to come, their initial cost being so much under that of hydro-electric plants. Senator Luiggi referred to the improved status of engineers in Italy and to the policies of the Italian government in encouraging hydro-electric and other public utilities to be carried through on private initiative but with government subsidies sometimes reaching 60 per cent of the cost. He referred also to the Italian utilities that were being transferred from goverrmental to private control.

The speakers were introduced by John W. Lieb, vice-president of the New York Edison Company, and the addresses of welcome were made by Farley Osgood for the electrical engineers, Fred R. Low for the mechanical engineers, C. L. Loweth for the civil engineers and J. V. W. Reynders for the mining engineers.

Rates Reduced in Four Towns on Wisconsin "Loop"

Rates for light, heat and cooking for residential consumers of electricity in Eau Claire, Chippewa Falls, Menomonie and Neillsville, Wis., have been reduced approximately 20 per cent by the Northern States Power Company in conformity with the stipulation agreed upon between these cities and the company, which provided that additional reductions were to be made if, after a six months' trial of the existing rates, it was shown that revenues were in excess of the reductions agreed upon. With the six months' rate experimental period at an end, the Wisconsin Railroad Commission found that the reduction named must be made. The agreement between the company and the cities, made last December, provided that rates should be charged which would yield $100,000 per year less than the company was collecting under the rates fixed by the commission based on the consumption figures of 1922.

The new rates will be 45 per cent lower than those contained in the commission order of 1920. From this order, it will be remembered, the cities appealed, and the case was carried to the Wisconsin Supreme Court, with the result of the abolition of the so-called "loop" system of rate fixing by which rates were equalized in towns receiving service from a common plant at a strategic point. The Supreme Court held that rates in each municipality must be based on the cost of serving that particular municipality regardless of the cost of serving neighboring cities or towns.

Del Monte Hotel Fire Routs Pacific Coast Jobbers

The fire which destroyed the main section of the famous Del Monte Hotel, Del Monte, Cal., early Saturday morning, September 27, brought to a sudden close the proceedings of the Pacific Coast Division, Electrical Supply Jobbers' Association, which had gathered for its annual convention on the previous Thursday. Many of those attending the meeting as well as other guests of the hotel lost all of their personal belongings. Fortunately most of the electrical men were in one of the wings which was not destroyed and had time to dress hastily and to pack their belongings.

R. H. Ballard, vice-president and general manager of the Southern California Edison Company, and J. P. Coghlan, assistant to the president of the Pacific Gas & Electric Company, were to have addressed the open meeting Saturday morning on the subject of "The Plans of California Utilities for the Coming Year."

Utilities' Financial Condition "Best Ever," Says Stone

Charles A. Stone, chairman of the board of Stone & Webster, Inc., Boston, in remarks at the opening session Monday of the third convention of managers of the sixty public utility companies under Stone & Webster executive management, asserted that the public utility industry is in the best financial condition in its history. Mr. Stone said:

"The public at last realizes that the big companies in the large cities and several groups like our own, made up mainly of companies in moderate-sized cities, are well managed and have a permanent and steady earning power that can be relied upon. We are therefore in better shape to increase our business by the investment of new capital than ever before. This applies especially to those companies which are conservatively capitalized. The keynote of this convention of Stone & Webster managers is the development of new business, and I am glad that I can advise you that new business can be taken on and financed today with greater confidence than ever before."

The convention meetings were held at the Hotel Bellevue and, besides Mr. Stone, most of the members of the firm addressed the visitors during the week. Companies under Stone & Webster management in many parts of the United States were represented.

Electric Development Topic at Steel-Treating Convention

Advances in electric heating occupied an important part of the program and exhibits of the American Society for Steel Treating convention held last week at Boston, with a large attendance. E. F. Collins, consulting engineer, industrial heating department, General Electric Company, read a paper urging a complete economic and quality analysis in each important application problem instead of emphasizing comparative B.t.u. costs only. Wirt S. Scott, Westinghouse Electric Manufacturing Company, reported 1,250,000 kw. estimated industrial electric heating apparatus in service in this country and said that this branch of the industry has had no recession. Other papers were upon X-ray analysis and physico-metallurgical subjects. A splendid exhibit of steel-treating apparatus and machinery was held during the week on Commonwealth Pier.

Applications Before Federal Power Commission

Two applications for preliminary permits have been filed with the Federal Power Commission by the Kentucky Hydro-Electric Company, covering a series of power houses on the Kentucky River. It is proposed to place a power house at each one of the navigation dams from No. 1 to No. 14 inclusive.

The Pacific Gas & Electric Company has applied for a license covering an existing diversion dam and canal,

a portion of which is on public lands. These works are a part of the lime saddle-coal canyon power project on the west branch of the North Fork of Feather River, near Oroville, in Butte County, Cal. The company requests that this license be granted as a minor part of the major project.

A complaint recently was raised by a large power company when it was denied full information as to the engineering plans of a small interest which had filed a conflicting application. It is the policy of the commission to consider as confidential the detailed maps and plans covering the proposed development of projects. This applies as well to the information furnished it by the applicant as to its financial ability to carry the work forward. The general plan of each proposed development is placed at the disposal of any caller desiring that information. In the case of this particular complaint the company took a different view of the matter when it was asked if it would be willing to allow a rival interest access to the costly engineering study filed by it in connection with an application.

Public Relations at Tenney Convention

Varied addresses on public relations characterized the fifteenth annual convention of the Tenney Service Association on September 26 at the New Ocean House, Swampscott, Mass., which was attended by representatives of companies under the management of Charles H. Tenney & Company from six states in the East, these utilities now having a combined invested capital of nearly $80,000,000, about 268,000 customers, an annual electrical output of nearly 260,000,000 kw.-hr., serving about one hundred municipalities and listing 3,228 employees. Addresses were given by Dr. Payson Smith, Massachusetts Commissioner of Education; B. F. Griffin, associate editor Boston News Bureau; Major Alexander Forward, secretary-manager American Gas Association; Representative Charles R. Underhill, R. L. Eltringham, assistant managing director National Electric Light Association; General A. E. Bliss, safety engineer, Charles H. Tenney & Company, Boston; C. W. Price, vice-president Elliott Service Company, New York, and H. C. Attwill, chairman Massachusetts Department of Public Utilities. An all-day outing with safety demonstrations was held on September 27.

Indianapolis Rates May Soon Be Reduced

Complaints made to the Indiana Public Service Commission, extending over several years, to the effect that the Merchants' Heat & Light Company and the Indianapolis Light & Heat Company had, in competition with each other, made rates for large consumers of power which were unauthorized by the commission and virtually involved rebates, have been adjusted through court proceedings. By the terms of the agreement, which was reached without the submission of evidence, the companies forfeited $2,000 each.

The commission has nearly completed the preparation of the data on which an order making a new adjustment of rates will be based. It is understood that the new order will make a considerable further reduction in the rates of power consumers, will probably place all consumers, both domestic and industrial, on the same block meter rate and will eliminate the demand charge to power consumers. Some of the commissioners at least favor a rate that will bring a reduction to the domestic consumer as well. On the block-meter basis all consumers would pay only for the amount of electrical energy actually consumed, with possibly a minimum charge.

Briefer News

Prairie du Chien (Wis.) Company to Be Absorbed by Interstate Power.—The Prairie City Electric Company of Prairie du Chien, Wis., is to pass under the control of the Interstate Power Company, from which it has been purchasing power. The price to be paid is quoted as $200,000.

Administrative Board of A. E. C. to Meet.—A meeting of the administrative board of the American Engineering Council has been called for October 17 and 18 in Chicago. The board will convene at the headquarters of the Western Society of Engineers, President James Hartness presiding.

Puget Sound Power & Light Reduces Rates.—A voluntary reduction averaging about 10 per cent in residence and commercial rates throughout its southern district is made in a new tariff filed with the Washington State Department of Public Works by the Puget Sound Power & Light Company. The reduction is attributed by the company to an increased consumption of power in the territory.

Doherty Interests Buy Ohio Property from Barstow.—The Northwestern Ohio Railway & Power Company of Oak Harbor, Ohio, formerly controlled by the General Gas & Electric Corporation and under the management of the W. S. Barstow Management Association, has been taken over by the Henry L. Doherty interests. The company is capitalized at $2,500,000 and serves a number of towns in the Toledo district.

Sixty-seven Iowa Towns Abandon Municipal Plants.—The town of Alvord, Iowa, has voted to sell its municipal electric lighting system to L. R. Schlicter of Sioux City and has granted him a franchise. The reason given is that the distributing system was about worn out and no funds had been set aside from earnings to replace it. This makes sixty-seven Iowa towns which have abandoned municipal ownership of electric light and power systems.

A New Plant for Quebec Province.—A hydro-electric power development which is destined to be of importance to the industrial future of the Laurentian country between St. Jerome and Ste. Agathe, Province of Quebec, was formally opened on September 16 by the Laurentian Hydro-Electric Company. The plant is situated on the North River, has been under construction nearly a year and has so far cost about $600,000. It will develop ultimately 14,000 hp.

Aiken (S. C.) Plant Goes to the J. G. White Company.—Through negotiations which have been in progress for some time control of the entire stock holdings of the Carolina Light & Power Company, which furnishes current for Aiken, S. C., has passed into the hands of the J. G. White Company, or will do so as soon as the transfer can be made. The White company developed the Stevens Creek plant on the Savannah River several years ago and at present controls the lighting and power franchise at Augusta, Ga. The same company, it is understood, is heavily interested in the Augusta-Aiken Railway & Electric Company, which controls the Georgia-Carolina Power Company and supplies energy for light and power.

New Transmission Lines in Southeastern Oklahoma.—New territory will be served with electrical energy when the Southwest Power Company completes construction of the 66,000-volt high-power transmission line from McAlester, Okla., to the Atoka County line to meet a transmission line that will be constructed to that point by the Public Service Company of Oklahoma, connecting with its properties at Atoka, Coalgate, Lehigh, Wapanucka and intermediate points. The Public Service Company owns the power plant at Atoka, but on account of unusually heavy demand for energy it has entered into a contract with the Southwest Power Company to purchase a supplemental supply of electricity from its McAlester plant.

General Electric Company Keeps Open House.—Thirty representatives of paper companies in the United States and Canada gathered in Schenectady recently as two-day guests of the General Electric Company. The occasion was the annual meeting of the General Electric pulp and paper mill specialists. After a trip through the plant and luncheon at the Mohawk Club, the visitors listened to papers on automatic hydro-electric stations, flowmeters and maintenance. The following day the subjects included high-pressure boilers and high-extraction turbines, electric welding and electric-steam generators. A trip was made through the research laboratory and there was a talk on the laboratory and its work by Dr. W. P. Davey. Another recent party visiting the General Electric plant as guests of the company contained twenty-eight officers and editors of the McGraw-Hill Publishing Company, who made the trip from New York to Albany in a special car and were transported to Schenectady by automobile. A tour of inspection through the plant was made in the

morning, and after luncheon an opportunity was given the various officers and editors to visit the departments of particular interest to them.

Twenty-Mile "White Way" from Jacksonville to the Ocean Proposed.—The new 31-ft. highway reaching from Jacksonville, Fla., to the Atlantic and Pablo beaches, 20 miles away, which will be completed next summer, will, if a decision arrived at by the County Commissioners is carried out, be illuminated in a manner that will make it one of the finest "white ways" in the country. The great expense involved will, the commissioners hold, be amply returned by the development the highway under such a plan will bring.

Farmers Opposing High-Tension Lines Because of Interference with Radio "Lose Out." — The Milwaukee Electric Railway & Light Company has won in the suit brought against it by numerous farm owners who sought to prevent the completion of the high-tension power line between the company's Lakeside plant, south of Milwaukee, and Racine. The farmers maintained among other reasons that the presence of the line would interfere with the reception of market reports by radio, thus decreasing the value of their property.

Plan for Illumination of Niagara Falls.—An elaborate scheme for the illumination of Niagara Falls by night was laid before the Ontario government a few days ago by a deputation of civic officials from Niagara Falls, Ontario, and Niagara Falls, New York. It was suggested that the government should pay one-third of the cost, estimated at $60,000, of installing a plant and maintaining it for the first year, to surround the Falls with varicolored lights. Niagara Falls, New York, offered to pay $39,000 and Niagara Falls, Ontario, $5,000 toward the initial cost, provided that the government of Ontario would contribute $15,000. Premier G. Hoard Ferguson agreed on the allocation of cost and virtually authorized immediate construction of the plant, subject to the formal ratification of the provincial cabinet. The cost of maintenance annually will be allocated in the same ratio.

New Azores Cable Develops Great Sending Speed.—Much satisfaction is expressed by the officers of the Western Union Telegraph Company over the operation of the new cable to the Azores, which was completed on September 19. This cable has developed a speed of 1,700 letters a minute, compared with the speed of 250 letters a minute of other cables now in service. Newcomb Carlton, president of the company, in announcing this result, said: "Although the cable's great operating speed is principally due to permalloy, the new nickel-iron alloy, there are other factors of importance. One is the recently invented terminal apparatus, which receives the incoming signals, modifying them and making them more legible. Another is the freedom from local electrical disturbances, always a serious handicap to all cables traveling east from our Atlantic coast. On account of the comparatively shallow water of the continental shelf on which the terminal sections of these cables are laid disturbances from neighboring electric power systems and from atmospheric sources are readily picked up by the cables." Engineers are at work on a printing telegraph which will enable six cablegrams to be forwarded simultaneously.

New Brunswick's Power Problem.—The lumbermen of the Province of New Brunswick are, it is said, beginning to realize that the future of its forestry industry lies in the production of newsprint paper. But few of the water powers of the province could by themselves produce the 5,000 continuous horsepower needed by a 50-ton newsprint mill. The problem has been taken up by the New Brunswick Hydro Commission, whose chief engineer, S. R. Weston, pointing out that the province possesses about 100,000 continuous horsepower, which could be increased to 200,000 hp. for twelve hours by a general system of storage under unified control, is of the opinion that, in the interests of economy and conservation, these water powers should not be treated separately, but as far at least as generation and high-voltage transmission are concerned must be treated collectively as integral parts of one complete system. He said that in a strictly technical sense it would be far more economical to use Grand Falls as a base-load generating station for the whole province—that is, to provide all power that is used twenty-four hours per day—and use the smaller sites for short periods of the day to provide the peak-load requirements. Grand Falls should be developed for a high load factor, with an ultimate installation of about 80,000 hp., and the other 120,000 hp. of equipment would, as required, be installed in the smaller plants, but would operate only part time.

Coming Meetings of Electrical and Allied Societies

[A complete directory of electrical associations is published in the first issue of each volume. See July 5 issue, page 50, for latest list.]

American Electric Railway Association—Atlantic City, N. J., Oct. 6-10. J. W. Welsh, 8 West 40th St., New York.

Empire State Gas and Electric Association—Lake Placid Club, N. Y., Oct. 6-7. C. H. B. Chapin, Grand Central Terminal, New York.

American Institute of Electrical Engineers—Pacific Coast convention, Pasadena, Cal., Oct. 13-17. F. L. Hutchinson, 33 West 39th St., New York.

American Institute of Mining and Metallurgical Engineers—Birmingham, Oct. 13-15. F. F. Sharpless, 29 West 39th St., New York.

International Association of Municipal Electricians—Partridge Inn, Augusta, Ga., Oct. 14-17. W. R. Arbuckle, Bayonne, N. J.

Electric Power Club—Greenbriar Hotel, White Sulphur Springs, W. Va., Oct. 20-23. S. N. Clarkson, B. F. Keith Bldg., Cleveland.

American Society of Civil Engineers—Hotel Tuller, Detroit, Oct. 22-25. C. E. Beam, 29 West 39th St., New York.

Kansas Public Service Association—Broadview Hotel, Emporia, Kan., Oct. 24-25. R. T. Smalley, Kansas Electric Power Co., Emporia.

Illuminating Engineering Society, Briarcliff Manor, N. Y., Oct. 27-31. N. D. Macdonald, 29 West 39th St., New York.

National Association of Railway and Utilities Commissioners—Phoenix, Ariz., Nov. 11-14. James B. Walker, New York Transit Commission, New York.

West Virginia Public Utilities Association—Charleston, W. Va., Nov. 14-15. Bliss McCrum, secretary.

Electrical Credit Association (Middle and Atlantic States)—Philadelphia, Nov. 14. F. P. Rose, Marquette Bldg., Chicago.

Electrical Supply Jobbers' Association—Hotel Cleveland, Cleveland, Nov. 19-21. Franklin Overbagh, 411 South Clinton Street, Chicago.

Control of Florida Utility Company Changes Hands.—The majority stock of the Southern Utilities Company, which, with headquarters in Palatka, Fla., has plants in St. Augustine, Fort Myers, Tarpon Springs, West Palm Beach, Punta Gorda, Arcadia, Bradentown, Live Oak, Sanford, Titusville and other Florida cities and towns, has passed from the J. G. White Management Corporation to the American Power & Light Company, which is said to be seeking also to acquire the minority shares.

Babson Building Great Map of United States Which Will Show Electrical Development.—Roger W. Babson, statistician and business authority, has begun to build on his property near Boston a great relief map of the United States which will show centers of industry, population, developed and undeveloped water power, rivers, forests, agricultural lands, mineral resources, railroads, traction lines, highways, transmission lines and power stations. The foundation of this map will cover about 5,000 sq.ft., and upon this base each of the forty-eight states will be reproduced to scale. A balcony will be built to give observers a bird's-eye view of the map, and present plans call for a powerful projector to be mounted in the ceiling directly above it. By the use of lantern slides it will be possible to color the map by lighting effects to show a given situation. Any desired subject can be pictured by a simple process of preparing the lantern slide with the proper shading or coloring. A traveling crane is also being constructed so that "airplane" pictures can be taken of any desired section of the country. The great map will be supplemented by detail maps on each state covering hydro-electric power developments, canals and inland waterways, detailed transmission routes by land, water and air, pipe lines and other industrial developments. It is thought that the map will be of especial service in the public utility, and especially the electric, field, since it will show power plants, transmission lines and interconnections completed or under way. Prominent electrical men are reported to be actively interested in its preparation. These include President Thomas W. Martin of the Alabama Power Company, President John B. Miller of the Southern California Edison Company, President H. T. Edgar of the Mississippi River Power Company, P. T. Hauscom of the General Electric Company and Henry L. Doherty.

Men of the Industry

C. A. Semrad New President of Rocky Mountain Division

Charles A. Semrad, who was elected president of the Rocky Mountain Division of the National Electric Light Association at the recent convention in Glenwood Springs, Col., as was announced in the September 20 issue of the ELECTRICAL WORLD, has been prominently identified with the electrical industry in Colorado for many years. After a short association with the Union Light & Power Company of St. Louis, he joined the Northern Colorado Power Company, the predecessor of the Western Light & Power Company, leaving after three years for Wyoming to become general manager of the Cheyenne Light, Fuel & Power Company. From 1918 to 1923 he was connected with the Western Light & Power Company in the capacity of vice-president and general manager, with headquarters in Boulder. When that organization was consolidated with the Denver Gas & Electric Light Company to form the Public Service Company of Colorado Mr. Semrad was made vice-president and assistant general manager of the merger company. Last summer, when the commercial department of the company was reorganized, he was appointed commercial manager, retaining the title of vice-president.

C. A. SEMRAD

T. Buell Card has resigned from the engineering department of the Blackstone Valley Gas & Electric Company, Pawtucket, R. I., to become resident engineer for the J. G. White Engineering Corporation at Oneonta, N. Y.

T. D. Fulford has been appointed sales manager of the Baton Rouge Electric Company to succeed J. C. Lamb, who has left the organization.

E. T. Steel, for eighteen years associated with interests managed by Stone & Webster, has been chosen to take the place of R. M. Boykin as manager of the southern division of the Puget Sound Power & Light Company with headquarters at Portland, Ore. Mr. Boykin has been promoted to be manager of the central division at Seattle. Mr. Steel is at present assistant to the chairman of the board of directors of Stone & Webster at Boston.

Edgar J. Allegaert has been appointed vice-president in charge of electric operation of the Public Service Electric & Gas Company, Newark, N. J., to succeed Farley Osgood, resigned. Mr. Allegaert has been connected with the company and its predecessors since 1899.

Captain Ralph Earle President Worcester Polytechnic

Captain Ralph Earle, U. S. N., commander Naval Torpedo Station, Newport, R. I., has been elected president of the Worcester (Mass.) Polytechnic Institute to succeed Dr. Ira N. Hollis, who has resigned to take up literary work after a long and distinguished career in engineering and technical education. Captain Earle was born at Worcester in 1874 and after attending the Polytechnic Institute was graduated from the United States Naval Academy in 1896. He served on the *Massachusetts* and *Hornet* from 1896 to 1898, and after tours of duty in various parts of the world became chief of ordnance with the rank of rear-admiral during the World War. He commanded the U. S. S. *Connecticut* 1919-1921, was chief of staff of control force, U. S. S. *Florida*, 1921-1922, was at the Naval War College in 1922, and then was transferred to the torpedo station.

William Schwanhausser, chief engineer of the Worthington Pump & Machinery Corporation, was the guest of honor at a dinner given recently by officials of the corporation in honor of his seventieth birthday and to mark the fortieth year of his continuous service with the Worthington organization.

Henry Cowgill, formerly general superintendent of the Ohio Public Service Company at Mansfield, a Doherty property, has been appointed general manager of the Northwestern Ohio Railway & Power Company, Oak Harbor, to succeed F. K. Woodring, who is assuming new duties in Columbia, S. C. The Northwestern company was taken over by the Doherty interests early in September from the General Gas & Electric Corporation.

F. B. Lewis Promoted

Fred B. Lewis, acting and assistant manager of operations of the Southern California Edison Company, Los Angeles, has been made assistant general manager of that company. Mr. Lewis has been with the organization for nineteen years, having joined its ranks immediately after his graduation in electrical engineering from the Rose Polytechnic Institute, Terre Haute, Ind. During his association with the Edison company he served in various capacities, and in the present water shortage he has had charge of co-ordination of plans for the exchange of power with other utilities. Mr. Lewis has been connected with many of the developments of his company and has taken an active part in system operations and extensions.

F. B. LEWIS

Obituary

W. J. Tonkin, assistant secretary and sales manager of the Ansonia (Conn.) Electrical Company, died September 22. Mr. Tonkin had been associated with the company for thirty-five years.

Charles C. Perry, president of the Indianapolis Light & Heat Company, whose death was announced in last week's issue of the ELECTRICAL WORLD, had been a leading figure in the electrical industry in Indiana since 1888, when he took the chief part in the organization of the company which he headed at the time of his death. Previously to this he had been associated with the Jenney Electric Corporation of Indianapolis. Mr. Perry was born in Richmond, Ind., in 1857. He attended the public schools of that city and later became a student at Earlham College, Richmond. He began life as a telegraph operator. Mr. Perry was a hard worker, absorbed in the management of his company, which, largely through his efforts, won a high place among successful electric utilities. He took a prominent part in the commercial activities of Indianapolis and was a former president of the Board of Trade. He had also served as president of the Indiana Electric Light Association.

Archibald S. White, banker and promoter of New York and Cincinnati, and president until 1917 of the New York banking firm of White & Company, died September 28 at Santa Rosa, Cal., in his fifty-seventh year. Mr. White was the organizer and first president of the Columbia Gas & Electric Company and before his retirement was an officer or director in many other corporations.

Financial and Corporate

Utility Prices Gain

But Gains Are Smaller than Those in Most Recent Weeks for List as a Whole

WITH the listed markets generally quieter, the unlisted market in power and light stocks was also somewhat quieter during the past week. The striking thing about the week was that, although the general trend of values continued upward, the gains were smaller than in recent weeks. A few of the utilities have made statements that indicated some falling off in business during July and August, but advanced reports indicate a picking up of the demand for service during September. Money continues easy, but there is nevertheless a pretty definite sign that the general direction of the cycle is toward better rather than poorer times in the immediate future.

The advance in American Water Works & Electric Company's shares to a new high at 126 was the most spectacular event of the week in the market for listed utilities, although there also arose a pronounced demand for Public Service Corporation of New Jersey stock. Demand for Public Service shares appears to result from the more general appreciation of the great possibilities for growth in the New Jersey field and the improved condition of the corporation under its new capital structure.

Among the unlisted issues United Light & Power A and B stocks rose 10 and 15 points respectively, but outside of these issues none of the active utilities rose more than 5 points, a thing that would not have been said of many recent weeks, if any. The stocks which gained about that much were Columbus Railway & Power, Continental Gas & Electric, General Gas & Electric, American Power & Light and Tennessee Electric Power. American Gas & Electric actually lost ground during the week, as also did Appalachian and National Power & Light.

American Water Works & Electric

An Analysis of This Company's Capital Structure, Which, Together with Earnings Growth, Explains Why the Stock Has Risen from 40 to 125

BY PAUL WILLARD GARRETT

ALL kinds of explanations have been advanced to account for the rise in American Water Works & Electric Company, Inc., stock from 40 at the beginning of 1924 to about 125 at present, just as all kinds of explanations were offered to account for the rise from 4 three years ago to 40. To any one who analyzes the company's interesting capital structure in conjunction with recent earnings reports there are some pretty obvious reasons why American Water Works & Electric Company stock has moved.

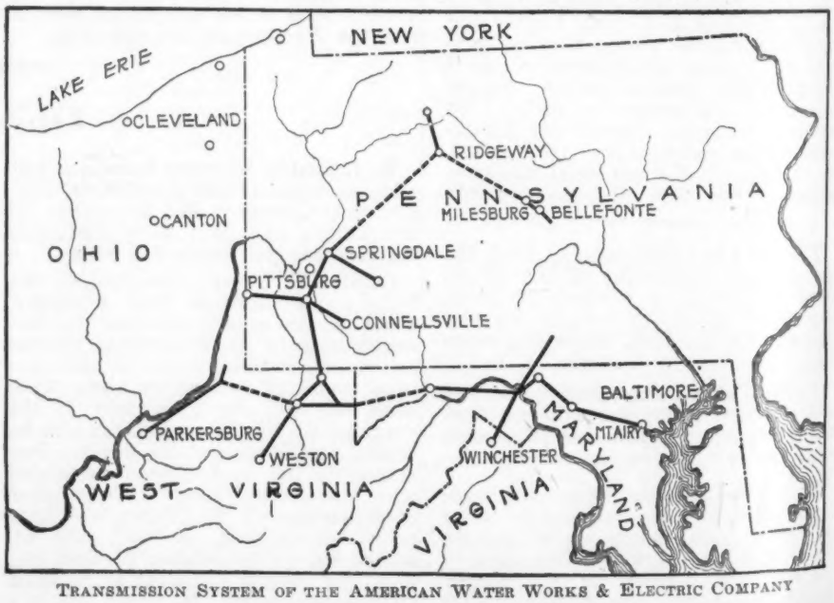
A striking feature of the capital structure is the relatively small amount of common stock authorized and outstanding. Here is a utility whose plant, property and investments stand at about $225,000,000 on the balance sheet, taking the consolidated statement which includes the holding company and its various operating companies. The investment in the utility is, in other words, large. But the amount of stock of the holding company (American Water Works & Electric) which in the final analysis will receive the earnings is small. About $13,654,000 of American Water Works & Electric Company bonds, the 5's of 1934, stand ahead of the stock. Then comes a $9,050,000 issue of cumulative first preferred which receives 7 per cent, $10,000,000 of participating preferred which now receives 6 per cent and $10,000,000 of common which has not, since the organization of the present company in 1914, received anything. That makes $29,050,000 in stock altogether. Furthermore, the ten-million-dollar issue of participating preferred stock is callable at 105, and it is only logical to expect that the company eventually will redeem this stock. That step would improve the position of the common shares just so much more.

There was a time not long ago when American Water Works & Electric Company's earnings were poor, but, following developments in the industry generally and some wise changes made by the company itself, recent figures are good. With gross earnings of $38,019,860 for the year ended July 31, 1924, taking the consolidated income account, the properties showed net income of $5,402,224. After charging off $2,450,163, or over 45 per cent of the net, for depreciation, there was still left $2,952,061. The latter figure is equivalent, after first preferred dividends, to $11.59 a share on both the 100,000 shares of common stock and the 100,000 shares of participating preferred stock. With relatively little stock outstanding, it does not take a very large increase in net income, of course, to swell materially the earnings on a per share basis.

The increased earnings result in part from the great growth in the business and addition of new properties, the kilowatt-hour output having increased from 154,973,930 in 1915 to 1,120,562,374 for the twelve months ended June 30, 1924. The latter figure, incidentally, compares with 985,632,674 kw.-hr. for the twelve months ended June 30, 1923.

SERVES A RICH TERRITORY

The electric system of the American Water Works & Electric Company forms an important part of the superpower group that extends, as the map shows, from Cleveland to a point within 25 miles of Baltimore. The company has a growing territory and has greatly increased its potential earning power by the recent acquisition of such utilities as the Potomac Edison Company. The three main power and light operating groups which now compose the American Water Works & Electric system are (1) the West Penn System, (2) the Potomac Edison Company and (3) the Keystone Power & Light Company.



TRANSMISSION SYSTEM OF THE AMERICAN WATER WORKS & ELECTRIC COMPANY

Recent Listings on Exchange.—The New York Stock Exchange has authorized the listing of the following securities: Federal Light & Traction, 6 per cent cumulative preferred stock, amounting to $45,800; Tennessee Electric Power, additional first and refunding mortgage gold bonds, series A, 6 per cent, amounting to $3,108,000; West

Stock and Bond Quotations of Electric Light and Power and Manufacturing Companies

(Prices on New York stock market unless otherwise noted. Unless otherwise noted the par value of stocks is $100.)

Companies	Bid Price Saturday, Sept. 27	Low 1924	High 1924
PREFERRED STOCKS			
Operating Companies			
Adirondack Power & Light 7 per cent	97	94	97¾
Appalachian Power, 7 per cent	90	85½	90
Arkansas Light & Power 7 per cent	90	81	93
Asheville Power & Light 7 per cent	96	96	99
Carolina Power & Light 7 per cent	98	95½	100
Central Illinois Public Service 6 per cent	84	84	87
Colorado Powar 7 per cent	93	90	97
Connecticut Light & Power 7 per cent	99	99	102
Consumers' Power 6 per cent	90	85	93
Dayton Power & Light 6 per cent	84	84	90
Duquesne Light 7 per cent	a106	102	108½
Eastern Texas Electric 6 per cent	96	81	96
Empire District Electric 6 per cent	73	70	78
Fort Worth Power & Light 7 per cent	97½	97	100
Great Western Power 7 per cent	98	96	99
Illinois Northern Utilities 6 per cent	82	82	87
Illinois Power & Light 7 per cent	92	84	95
Kansas Gas & Electric 7 per cent	93	92	97
Long Island Lighting 7 per cent	98	95	98
Minnesota Power & Light 6 per cent	89	78	89
Mississippi River Power 6 per cent	87	80	90
Nebraska Power 7 per cent	95½	89	99
Niagara Falls Power 7 per cent—25	27¼	26	29
Niagara, Lockport & Ont. Power 7 per cent	101½	99½	104½
Northern States Power 7 per cent	94	91	97
Ohio Public Service 7 per cent	94	86	100
Pacific Gas & Electric 6 per cent	90	85½	92½
Penn-Ohio Power & Light 7 per cent	91	84	96½
Pennsylvania Power & Light $7—no par	98	93	99
Penn. Public Service 7 per cent	90	90	100
‡Philadelphia Electric 8 per cent—25	a 38½	29¼	39⅜
Southern California Edison 8 per cent	117	112	120
Tennessee Electric Power, 6 per cent	78	71	81
Texas Power & Light 7 per cent	96½	95	96½
Utah Power & Light 7 per cent	96	94	96½
Western States Gas & Electric 7 per cent	80	78	85
Yadkin River Power, 7 per cent	97	94	97
Holding Companies			
American Gas & Electric 6 per cent—50	44½	41⅓	46
American Light & Traction	92½	91	94½
American Power & Light 6 per cent	90	84	91
American Public Service 7 per cent	80	84	92
American Public Utilities 7 per cent	82	73	88
American Water Works & Electric 6 per cent	a 90	66	99
Carolina Power & Light 7 per cent	99	95½	99½
Central Indiana Power 7 per cent	89	80	92
Cities Service 6 per cent	75½	67	77
Commonwealth Power	a 77	72	82
Consolidated Gas 6 per cent—50	58	51	59½
Continental Gas & Electric 7 per cent	88	69	93
Electric Bond & Share 6 per cent	100	96½	103
General Gas & Electric—$8—no par	102	96	103½
Middle West Utilities 6 per cent	88	80	90
National Power & Light—$7—no par	93	84	96½
North American 6 per cent—50	a 48½	43½	50½
Northern Ohio Electric	a 24	16	34
Public Service Corp. of N. J. 7 per cent	a100	96½	100½
Public Service Corp. of N. J. 8 per cent	a108	99½	110
Standard Gas & Electric 8 per cent—50	48½	46½	49½
‡United Gas Improvement—50	56½	55½	58
United Light & Power—$6.50—no par	84	75½	84
COMMON STOCKS			
Operating Companies			
Adirondack Power & Light—50	32	22½	34
Appalachian Power—no par	75	66½	93
Arkansas Light & Power	60	22	63
Brooklyn Edison	a 119	107½	120
Buffalo General Electric	149	118	155
Carolina Power & Light	230	82½	245
Colorado Power	33	21	35
Commonwealth Edison	132	126	135
§Consolidated Gas, Electric Light & Power	141	108	141½
Dayton Power & Light	160	70	160
Detroit Edison	a 109¾	102½	110½
|| Edison Electric Illuminating of Boston	a 180½	163½	190
*Kentucky Hydro-Electric	87½	84	87½
Long Island Lighting	175	100	195
Mississippi River Power	33	18½	34
Montana Power	a 66	61½	71
Niagara Falls Power—no par	42	42	48
Niagara, Lockport & Ontario Power—no par	51	45	59
Northern Ohio Electric—no par	8	5	16
Northern States Power	101	92	106
North Texas Electric	61	58	84
Pacific Gas & Electric	a 98½	90½	98⅝
‡Penn Central Light & Power—no par	59½	57	60
Pennsylvania Water & Power	107	98¾	110
‡Philadelphia Electric—25	a 39	29	39⅜
Public Service Co. of Northern Illinois	97	97	104
Puget Sound Power & Light	54	43½	61½
Southern California Edison	98	95	106
Tampa Electric	a162	134	162
Tennessee Electric Power—no par	42	20	43
Virginia Power	60	16	70
Virginia Railway & Power	a 68½	36	72½
West Penn. Co.	a 88	47½	98

Companies	Bid Price Saturday, Sept. 27	Low 1924	High 1924
Holding Companies			
‡American Electric Power—50	62	22½	62½
American Gas & Electric—no par	93	43½	97
American Light & Traction	135	115	140½
American Power & Light (old)	a480	200	480
American Power & Light (new)	48½	34½	48½
American Public Utilities	84	35	97
American Water Works & Electric	a121½	40	126½
Carolina Power & Light—no par	236	103	240
Cities Service	143	140	155
Columbia Gas & Electric—no par	a 42⅜	33	44½
Commonwealth Power Corp.—no par	109	56	109
Consolidated Gas—no par	a 73¾	60⅝	75½
Continental Gas & Electric	76	49	78
Federal Light and Traction	a 86½	75	86½
General Gas & Electric	63	22	63
Lehigh Power Securities—no par	87	31	89
Middle West Utilities—no par	82	41	86
National Power & Light—no par	182	60	190
Philadelphia Co.—50	a 51	42¾	53½
Power Securities—no par	11½	4	14
Public Service Corp. of N. J.—no par	a 62½	39	63
Standard Gas & Electric—no par	a 39½	31½	40½
United Gas & Electric (Conn.)—no par	32	14	42
Utah Securities	a 35½	16¼	37
BONDS			
Operating Companies			
Adirondack Power & Light 6s 1950	102½	97½	103
Alabama Power 5s 1946	95½	90½	96
Appalachian Power 5s 1941	95	89	95
Brooklyn Edison 5s 1949	a100⅞	97½	102½
Brooklyn Edison 6s 1930	a105½	102½	106½
Brooklyn Edison 7s 1940	a109¼	107	110½
Central Indiana Power 6s 1947	94	88	95
Cleveland Electric Illuminating 5s 1939	100¾	98½	101
Commonwealth Edison 5s 1943	99½	95	100
Commonwealth Edison 5s 1953	98⅛	92	99½
§Consol. Gas, Elec. Lt. & Pwr. 4½s 1935	95¾	91	95¾
Consol. Gas, Elec. Lt. & Pwr. 6s 1949	a 105	101½	105
Consol. Gas, Elec. Lt. & Pwr. 6½s 1957	108¾	107	108½
Consumers' Power 5s 1936	98½	94½	99½
Consumers' Power 5s 1952	a 90¾	87	92½
Detroit Edison 5s 1933	99¾	99	100⅛
Duquesne Light 6s 1949	a105½	103½	106½
Great Western Power 5s 1946	95	90½	96
Kansas City Power & Light 5s 1952	a 94⅞	89	95⅝
Mississippi River Power 5s 1951	96½	92	97
Montana Power 5s 1943	a 98½	95	98½
New England Power 5s 1951	98½	97	100
New York Edison 6½s 1941	a112½	109¾	112½
Niagara Falls Power 6s 1950	105½	104	105½
Northern States Power 5s 1941	a 93⅝	89½	94
Northern States Power 6s 1941	a103½	101	104½
Ohio Power 7s 1951	106	103	106½
Pacific Gas & Electric 5s 1942	a 93½	90½	95
Pennsylvania Water & Power 5s 1940	99	96	99½
‡Philadelphia Electric 5s 1966	a101½	97	103½
Philadelphia Electric 5½s 1947	103¾	99½	103½
Philadelphia Electric 6s 1941	107	103½	107½
Portland Electric Power 6s 1947	a 94½	89½	95½
Southern California Edison 5s 1939	98½	96	99
Southern California Edison 6s 1944	102½	100	103½
Tennessee Electric Power 6s 1947	a 98	93½	98½
Texas Power & Light 5s 1937	96	91½	96
Toledo Edison 7s 1941	a108⅜	106	109
Utah Power & Light 5s 1944	a 91½	87½	93½
Holding Companies			
Alabama Traction, Light & Power 5s 1962	81½	65½	83
American Gas & Electric 6s 2014	95½	94	95⅝
American Power & Light 6s 2016	94½	91	94½
Amer. Water Works & Electric 5s 1934	a 91½	84½	94
Commonwealth Power 6s 1947	a 98	87	98
Consolidated Cities Lt., Pwr. & Tr. 5s 1962	74½	64	75½
Illinois Power & Light 6s 1953	99	95	100½
United Light & Railways 5s 1932	93½	87½	93½
United Light & Railways 6s 1952	95½	92	96

ELECTRICAL MANUFACTURING COMPANIES

PREFERRED STOCKS			
Allis-Chalmers Manufacturing	100	90	100⅝
*National Carbon	122	112	125
Worthington Pump & Machinery (A)	a 82½	68	85
COMMON STOCKS			
Allis-Chalmers Manufacturing	a 60¾	41⅝	66½
American Bosch Magneto—no par	a 28½	22½	38¾
Electric Storage Battery—no par	a 58½	50½	64
General Electric	a 260½	193½	281
General Electric—10	a 11⅞	10½	11½
*Hurley Machine—no par	a 62	48	64½
†Wagner Electric	25½	20	25½
Westinghouse Electric & Manufacturing—50	a 62¾	55½	65
Worthington Pump & Machinery	a 45	23½	47½
BONDS			
Canada General Electric 6s 1942	106½	102½	107
General Electric 3½s 1942	83	80	83½
General Electric 5s 1952	104½	100	105
Robbins & Myers 7s 1952	76	75½	91½
†Wagner Electric Manufacturing 7s	100½	97	100½
Western Electric 5s 1944	a 98½	96	98½
Westinghouse Electric & Mfg. 7s 193	a 108½	106½	109½

*Chicago Stock Exchange. †St. Louis Stock Exchange. ‡ Philadelphia Stock Exchange. || Boston Stock Exchange. § Baltimore Stock Exchange.
a Bid price Wednesday, October 1.

Penn, additional 7 per cent cumulative preferred stock, amounting to $3,508,300; North American, additional common stock, amounting to $712,250; Pacific Gas & Electric, additional common stock, amounting to $5,000,000. The Philadelphia Stock Exchange has authorized the listing of additional common stock of the Philadelphia Electric Company, amounting to $205,750.

Utility Financing for Nine-Month Period

Total Amount of Issues by Public Service Companies Shows a Material Increase Over 1923 Figure

ELECTRIC light and power securities totaling $83,998,000 were offered by investment houses during the month of September as compared with $84,052,000 during August, 1924, and with $37,150,000 during September a year ago. The amount of financing recorded for the month, which marks the close of the third quarter of the year, brought the total for the nine-month period up to $719,310,700. This figure represents an increase of $213,521,300 over that covering new financing of light and power utilities during the same period of 1923. Though three of the issues during September of the current year were $15,000,000 offerings and thus contributed more than half of the entire total, a larger number of small issues than usually appear were floated. Refunding was more prominent than it has been during recent months when the new issues for the most part represented applications for new capital. Long-term financing predominated and the average rate of yield was 6.26 per cent.

Company Reports

Among the company reports issued during the past week for the month of August are the following:

Name of Company	Gross Revenues for August 1924	Gross Revenues for August 1923
Arkansas Light & Power	$212,167	$170,047
Asheville Power & Light	105,498	86,911
Associated Gas & Electric	597,911	299,068
Bangor Railway & Electric	123,141	126,854
Carolina Power & Light	196,604	168,216
Commonwealth Power	2,279,961	2,298,417
Consumers Power	1,372,934	1,299,924
Continental Gas & Electric	678,608	632,908
Cumberland County Power & Light	321,358	325,590
East Penn Electric	243,531	232,316
Fort Worth Power & Light	238,898	245,187
General Gas & Electric and subsidiaries	1,543,984	1,286,184
Georgia Railway & Power	1,258,681	1,232,682
Great Western Power	639,315	592,172
Idaho Power	259,155	237,448
Kansas Gas & Electric	380,192	372,624
Manchester Traction, Light & Power	196,112	207,354
Massachusetts Lighting	277,529	260,059
Nebraska Power	308,246	295,716
Nevada-California Electric	351,008	321,334
Newport News & Hampton Railway, Gas & Electric	188,451	196,579
Northern Ohio Electric	801,689	790,869
Pacific Power & Light	264,967	267,564
Philadelphia Company	2,493,511	2,657,371
Portland Electric Power	839,852	861,513
Southern Canada Power	87,152	78,577
Tennessee Electric Power	744,692	736,766
Texas Power & Light	462,907	398,090
United Gas & Electric	1,074,667	1,066,762
Utah Power & Light	778,480	728,481
Virginia Railway & Power	846,681	861,208
Washington Water Power	441,730	421,256
Yadkin River Power	149,501	140,411

Baltimore Company Plans Split in Stock.—A special meeting of the stockholders of the Consolidated Gas, Electric Light & Power Company of Baltimore has been called for October 21 to vote on a split-up of stock recommended by the directors. The plan provides that four common shares of no par value be issued in place of each $100 share outstanding at present.

Malden Asks Stock Increase. — The Malden Electric Company has petitioned the Massachusetts Department of Public Utilities for authority to issue additional capital stock of a par value of $801,000, to be sold at $37.50 per share, to realize $1,201,500.

Dividends Declared

The following quarterly dividends were announced by central-station companies during the seven-day period ended September 30:

Name of Company	Per Cent	When Payable
American Electric Power, pf.	1¾	Nov. 15
Bangor Railway & Electric, pf.	1¾	Oct. 1
Eastern Texas Electric	$1.25	Oct. 1
El Paso Electric, pf, A	$1.75	Oct. 15
El Paso Electric, pf. B	$1.50	Oct. 15
Fall River Electric	2	Oct. 1
Fort Worth Power & Light, pf.	1¾	Nov. 1
Georgia Light, Power & Railways, pf.	1½	Oct. 1
Harrisburg Light & Power, pf.	1¾	Sept. 30
Illinois Power & Light, 7% pf.	1¾	Oct. 1
Illinois Power & Light, 6% pf.	1½	Oct. 1
Interstate Public Service, prior lien stock	1¾	Oct. 15
Iowa Railway & Light, pf.	1¾	Oct. 1
Kansas City Power Securities, com.	$2	Oct. 1
Kansas City Power Securities, pf.	$1.25	Oct. 1
Kentucky Utilities, pf.	1¾	Oct. 15
Long Island Lighting, pf.	1¾	Oct. 1
Louisville Gas & Electric, pf.	1¾	Oct. 15
Massachusetts Lighting, com.	50c.	Oct. 7
Massachusetts Lighting, 6% pf.	1½	Oct. 15
Massachusetts Lighting, 8% pf.	2	Oct. 15
Michigan Gas & Electric, pf.	1¾	Oct. 21
Michigan Gas & Electric, prior lien	1¾	Oct. 15
Nashville Railway & Light, pf.	1¾	Sept. 29
Pacific Gas & Electric	$2	Oct. 15
Pittsburgh Utilities, com.	$1	Nov. 1
Pittsburgh Utilities, pf.	35c.	Nov. 1
Pittsburgh Utilities, pf. (extra)	25c.	Nov. 1
San Diego Consolidated Gas & Electric, pf.	1¾	Oct. 15
Southern Cities Utilities, com.	¼	Oct. 10
Southern Cities Utilities, pf. (monthly)	58⅓c.	Oct. 10
Southern Indiana Gas & Electric, 7% pf.	1¾	Oct. 1
Southern Wisconsin Electric, com.	2	Oct. 25
Southern Wisconsin Electric, pf.	1¾	Oct. 15
Virginia Railway & Power, pf.	1¼	Oct. 20
Western Power, pf.	1¾	Oct. 15
Worcester Electric Light	3	Sept. 30

SECURITY ISSUES OF ELECTRIC SERVICE COMPANIES IN SEPTEMBER

Name of Company	Amount of Issue	Period, Years	Class	Purpose	Interest Rate	Price	Per Cent Yield
Interstate Power Company (Ill.)	$6,000,000	20	First mortgage gond bonds, series A	Retirement of bonds, acquisition of properties and other corporate purposes	6	96	6.35
Central Indiana Power Company	1,500,000	3	Collateral gold notes	To reimburse for expenditures on additions to property	5½	99¾	5.60
West Missouri Power Company	870,000	20	First mortgage gold bonds	Acquisition of new properties and additions to present properties	6½	100	6.50
Public Service Company of Colorado	10,000,000	30	First mortgage and refunding gold bonds, series B	Refunding, to reimburse for expenditures for properties acquired and improvements to property and for other corporate purposes.	5½	93	6
Northwestern Power & Light Co. (Wash.)	800,000	20	First mortgage sinking-fund gold bonds	To retire bonds and partially to refund cost of additions	6½	100	6.50
Central Illinois Public Service Co.	85,000	..	Cumulative preferred stock		6	85	7.06
Terre Haute, Indianapolis & Eastern Traction Co.	425,000	5	Collateral gold notes	To reimburse for expenditures on additions and improvements	6½	100	6.50
Coast Valleys Gas & Electric Co. (Cal.)	250,000	..	Cumulative preferred stock, series B	To provide funds for additions and extensions	7	100	7
General Gas & Electric Corp. (N. Y.)	1,575,000	..	Cumulative preferred stock, class A	Acquisition of stocks of other companies	8	105	7.62
Public Service Co. of Oklahoma	3,275,000	25	First mortgage gold bonds, series B		6	96½	6.30
Indiana Service Corp.	1,293,000	26	First and refunding mortgage gold bonds, series A	Acquisition of property and for additions and improvements	5	88¾	5.85
Puget Sound Power & Light Co.	5,000,000	25	First and refunding mortgage gold bonds, series A	Construction	5½	97	5.70
Central States Electric Corp. (Va.)	3,000,000	2	Secured gold notes	Redemption of notes	5	99	5.50
Columbia Gas & Electric Co. (N. Y.)	15,000,000	..	Cumulative preferred stock, series A	To reimburse treasury for capital expenditures, for maturing obligations and for construction	7	100	7
Inter-County Power & Light Co. (Ark.)	150,000	20	First mortgage sinking-fund gold bonds		6	92½	6.70
Miami Valley Electric Co. (Ohio)	125,000	21	First mortgage and refunding sinking-fund gold bonds		6	92½	6.60
Northeastern Iowa Power Co.	400,000	5	First lien and refunding mortgage gold bonds, series A	To pay in part for new properties and to reimburse for construction expenditures	6	100	6
Public Service Electric & Gas Co. (N. J.)	15,000,000	40	First and refunding mortgage gold bonds	Refunding and for additions	5½	96½	5.70
Southwestern Power & Light Co. (Tex.)	3,500,000	19	First lien gold bonds	To retire notes and for other corporate purposes	5	91½	5.75
Columbia Water & Light Co. (Tenn.)	250,000	17	First mortgage gold bonds	New capital	6	90	7
Southwest Power Co.	500,000	..	Cumulative preferred stock		7	92½	7.57
Duquesne Light Co. (Pa.)	15,000,000	..	First preferred stock, cumulative, series A	Additions and extensions	7	106	6.60
Total	$83,998,000						

Commission Rulings

Contributions to Cost of Building Lines as They Affect Old and New Customers.—The Wisconsin Railroad Commission in passing upon an application from the Badger Public Service Company made the following rules: (1) No connection charge payable to parties who financed original lines should be required in the case of an extension or extensions from those lines or any of them into territory not immediately contiguous to the line or lines, or to serve parties not regarded as prospective customers of the existing lines. (2) Additional patrons to be served from a line toward which contributions have been made by other subscribers should not be required to pay interest on the amount of their pro rata cost of the line from the time of original construction to the date of their connection.

Deprivation of Property and Right of Abandoning Service at a Loss.—Affirming that the constitutional rights of utility owners would be invaded by an attempt to require continued operation if it appears that such operation must inevitably result, not only in a failure to obtain a reasonable return, but also in an actual out-of-pocket loss from operation, the Wisconsin Railroad Commission granted authority to the Red River Manufacturing Company to discontinue electric service which it had been rendering to the residents of Phlox apparently without realizing that it had thus become a public utility company. The service had been rendered at a loss, and the commission asserted that the fact that consumers had for many years received it through the good will of the company did not justify them in demanding a continuation of the more or less benevolent arrangement.

Additions to and Subtractions from Rate Base.—In establishing new rate schedules for the Midland Counties Public Service Corporation, as the result of an increase in the cost of power purchased by this company from the San Joaquin Light & Power Company, the California Railroad Commission made the following among other decisions: A claim for materials and supplies on hand, based on the balance shown in materials and supplies account, was not accepted since it included supplies for construction work as well as for the operation of the plant. Working cash capital was determined by considering the cost of purchased power for one month and of operating expenses, exclusive of taxes and depreciation, for two months, with a deduction of one-fourth of the state taxes for the year. The estimated requirement for taking over transformers used by agricultural consumers was included. Money advanced by consumers for line extensions and held without payment of interest was deducted. Charges on a steam plant which no longer played a useful part were excluded from operating expenses. An estimate of federal taxes payable was not allowed to include an amount chargeable against operations in prior years. Agricultural power service was placed upon a yearly basis and the company was required to own necessary transformers. Rates for electricity used for heating which produced less than the cost of service were ordered corrected in order to avoid discrimination.

Considerations Governing Municipal Plant.—In adjudicating an application from the Hyrum City municipal electric plant for permission to increase rates, the Utah Public Utilities Commission condemned as improper the diversion of the depreciation funds of a municipal plant to the general fund of the city, declared that the managers of the plant should make a serious effort to collect past-due accounts in order to avoid discrimination against those paying their bills, and asserted that, in order to avoid discrimination, the demand element in a given electric rate, after an allowance for diversity, must reflect the charges upon investment made to serve customers taking service under such rates. An increase in electric rates of a municipal plant should be made by revising power rates rather than increasing lighting rates, the commission further said, if the demand element in the rates is such that bills of power users are paid in part by taxpayers.

Recent Court Decisions

Colorado Commission Without Power to Regulate Rates of Municipal Plant.—It has been again decreed by the Colorado Supreme Court that the Public Utilities Commission has no power under the state constitution and statutes to fix rates for a municipal electric plant (Holyoke vs. Smith). The court said that when the commission fixed rates to be charged by a lighting plant owned and operated by a municipality it performed a municipal function within the meaning of a constitutional prohibition against legislative delegation to any special commission, private corporation or association of any power to make, supervise or interfere with any municipal improvement, money, property or effect, or to perform any municipal function whatever. The court said further that on principle it would seem entirely unnecessary to give a commission authority to regulate the rates of a municipally owned utility since the only parties to be affected by the rates were the municipality and its citizens, and, since the municipal government was chosen by the people, they needed no protection by an outside body. If the rates for electric light or power were not satisfactory to a majority of the citizens, they could easily effect a change, either at a regular election or by the exercise of the right of recall. (226 Pac. 158.)*

*The left-hand numbers refer to the volume and the right-hand numbers to the page of the National Reporter System.

State's Powers Over Water Appropriation on Non-Navigable Streams.—In a suit brought by the Oregon Lumber Company against the East Fork Irrigation District, the Pacific Power & Light Company and others to determine the relative rights of the contestants to the use of the waters of the Hood River and its tributaries, the Supreme Court of Oregon declared that a state may change the common-law rule as to every stream within its dominion and permit appropriation of flowing water for such purposes as it deems wise, with the limitation that, without consent of Congress, a state cannot destroy the right of the United States to water necessary for beneficial use for government property, and limited also by the superior power of the United States to prevent interference with navigable streams. A power company, the court decreed, has no right to a continuous flow of water as riparian owner where its land belonged to the state at the time of passage of the Oregon law declaring all waters within the state to belong to the public, but is only entitled to water appropriated under the statutes. (227 Pac. 1065.)

Refund on Previous Payments Refused to Customer Whose Rate the Commission Reduced.—The Utah Public Utilities Commission reclassified the schedules of the Utah Power & Light Company in such a way that a material reduction was made in the rates paid for electrical energy by the Utah-Idaho Central Railway Company. Thereupon the railway company demanded that the commission declare it entitled to reparation because of charges paid in the past and upon the commission's refusal to make such an order brought suit against it. The Supreme Court of Utah has decreed that the commission had no power to grant such reparation, the old rate having been the one specified in the company's schedules as on file at the time it was enforced. "We are of the opinion," said the court, "that the commission was clearly right. If a party who is affected by a rate may apply for and receive reparations every time a rate is reduced, it follows that every time the rate is raised the party furnishing the service must also be permitted to apply for and receive the amount of the increase. There would thus never be any point at which a rate could be said to be permanent. The fact is that in the very nature of things the rates promulgated by the commission must be deemed permanent, unless the commission expressly provides to the contrary and in the order itself provides what the rights of the parties shall be with respect to the rates. Moreover, rates or charges for services rendered by a public utility, like those rendered by the company in the instant case, in the very nature of things, require adjustment either up or down from time to time, as changes in conditions or circumstances may require. The rates that are promulgated must, however, be deemed the rates to be charged upon the one hand and paid upon the other, whether they continue in force for a long or for a short period, unless the commission orders otherwise in the order promulgating the rates." (227 Pac. 1025.)

Manufacturing and Markets

Evolution in Wiring*

How Theories Have Changed with the Acquisition of Experience—Possible Economies to Be Derived from a Thoroughly Grounded System

By R. S. Hale
Edison Electric Illuminating Company of Boston

QUALITY and prices of wiring are fully as important as quality and prices of appliances, and the importance of wiring is nothing new. The problem of wiring quality has been up before. The rules used to forbid conduit, saying that no current-carrying wire, even if insulated, could come in contact with metal. They used to require us to fuse our neutral until the blowing of the neutral fuse caused so much trouble that they had to permit the solid neutral. They used to forbid grounding until accidental high-tension crosses killed so many people that they had to permit us to ground. They used to—or at least an interpretation of rules used to—discourage convenience outlets and force percolators and toasters on to chandelier sockets.

In each case the improvement came as a development, as part of the evolution. The central-station managers, keeping in touch with the needs of their customers, seeing the need of conduit, seeing the need of grounding, seeing the danger of fuses on the neutral, seeing the need of convenience outlets, have been the driving force behind these improvements, just as they had to fight for better and cheaper appliances.

Evolution of wiring has brought us to the present point in spite of reactionaries who want us to stand still. Shall we take the advice of these reactionaries and leave wiring alone, or shall we ask for the definite improvements to which evolution points?

Changes in Grounding Practice

The early wiring circuits were of two kinds, one kind being a completely insulated circuit, such as we have when we connect a lamp to a battery by two wires, the other being the ground-return circuits of the early telegraph systems.

After telegraphy, the next development was for lighting and power, using the dynamo with considerably higher voltage and amperage than before. For these the complete circuit was clearly necessary, and it was known to electricians that if a single point only of the circuit was connected to the ground, no current would leave the circuit. A completely insulated circuit could suffer one accidental ground without harm, while a circuit with one ground might be in trouble if a second ground occurred.

When, however, these systems, particularly the Edison three-wire system, covered large underground networks, grounds began to appear on the neutral wire. In some even of the very early three-wire systems the neutral was intentionally grounded, though this was against the Underwriters' rules. The point I want to make is to show how evolution changed the attitude from a complete prohibition of all grounds to allowing some grounds.

Parallel with the grounding of the Edison systems came the discovery that high-tension crosses did occur from either arc or 2,300-volt wires coming in contact with distribution wires and that when such crosses occurred the high-tension current went to ground the first chance it could get. If the low-tension system had been installed in accordance with the rules as an insulated system, the first accident occurred when some householder touched a socket and was killed. It was a real step forward when we discovered that if one intentional ground were made to the low-tension system, a cross with the high-tension system would go to ground through the ground wire and not through the person.

The next step was to have two intentional grounds, one at each house of two houses fed from the same transformer, so that if one ground failed, the other should still be effective. Evolution therefore brought us from the insulated circuit to the underground circuit with many unintentional grounds and to the alternating-current low-tension circuit with two or more intentional grounds.

The evolution of wiring has carried us from no grounds to many grounds. It would seem perfectly clear that evolution will give us more grounds. I have never heard of any attempts to remove grounds on the neutral or grounded wire. In the course of time the number of such grounds will keep increasing. The next step appears to lead to a thoroughly grounded system—a system whose return wire is grounded at many more points than is now customary—a system with its return wire grounded whenever possible so that it can never get ungrounded.

What Thorough Grounding May Bring

What can we do with a thoroughly grounded system that we cannot do now?

We can, of course, leave off some of the insulation on the grounded wire. Today not only the grounded wire but the ground wire must be insulated for 600 volts. This is on the theory that the system may lose its ground connection. If, however, the system is thoroughly grounded, then this danger disappears. Then why should we insulate a wire that is solidly attached to a water pipe? We must still protect the grounded wire from mechanical injury—as, for instance, by putting it in a metal conduit—but we can leave off the rubber and save one-half the cost, one-sixth the wire cost of a three-wire system, one-quarter the wire cost of the two-wire. They have done this in the service pipes in Washington, Rochester and elsewhere. Evolution is still going on.

Besides this, we can make the conduit smaller. Bare wire is a better identification than is paint. Labor, while not always proportional to material, almost always goes down when less material is used. In the socket, panelboard, switch box and elsewhere the return wire can be solidly attached to the frame. In the case of sockets the lining and

*From a paper read before the sales managers' convention, July 23-25.

outside shell can be cut down considerably without decreasing the current capacity or needed strength.

How much can we save? I believe a large percentage of the cost of wiring is now devoted to this unnecessary insulation of wires solidly connected to ground. Even if we were so rich as not to want to save this, I do feel that we at least might take the amount now wasted and use it to protect the hot wire better. Whether large or not as a percentage of the total cost, it is worth while either to save in dollars or to use the saving to get other advantages.

The real thing needed is sentiment —sentiment promoted by all branches of the industry. Evolution goes on whether we do anything about it or not, but any of us who know about selling goods know that if we go after a thing we get it quicker. If the central-station man asks for thoroughly grounded systems, the manufacturers, the architect and contractors will provide them unless some entirely unforeseen development of danger should make us change our minds and not want them.

We don't always go in the same direction. We went from carriages to horse cars on rails, then to trolleys, and are now going back to horseless, railless, trolleyless automobiles. Rules and laws and ordinances delayed but did not stop these developments. Evolution of wiring may possibly take a turn away from thoroughly grounded systems, but all the evidence is the other way.

Certificates of Origin of American Exports to Spain

SPANISH importers of American merchandise in Spain are continually having trouble with the matter of certificates of origin accompanying goods consigned to them. In the first place, goods shipped from the United States to Spain direct must be accompanied, in practically all cases, by certificates of origin, visaed by the Spanish consul at the United States point of embarkation. Owing to the lack of technical knowledge in customs offices in Spain, according to the *Anglo-American Trade*, it is exceedingly important that the articles be described in the exact wording of the Spanish general customs tariff classification, otherwise the customs authorities are apt to give the articles the wrong classification and to levy duties in excess of those that should apply. All shippers of merchandise to Spain should, therefore, consult the Spanish consular authorities in the port of embarkation, in order that their certificates of origin—if they are necessary for the particular shipment—may be made out in proper form, using the exact wording of the Spanish general customs tariff classification.

As to the importation of goods into Spain from the United States, when the goods have been transshipped in a third nation, where a distribution center may be maintained, the Spanish law requires that such goods must be accompanied by a certificate of origin, whether such a certificate is required for their entry into the third nation or not. In case these goods are not accompanied by a certificate of origin, they must be deposited in an official government warehouse while in transit through the third nation, and must enter Spain accompanied by a transit certificate from the officials of this warehouse, properly visaed by the Spanish consul resident in the third nation. If no official warehouse is available in the third nation, the distributors should arrange with the American manufacturers to have the certificates of origin properly made out before the goods leave the United States.

If this matter is given proper attention, the United States manufacturers and shippers interested in the Spanish market will not only aid their representatives in Spain, but will aid their own business by establishing a reputation for carefulness and interest in such details, which often lead to untold trouble.

Electric Sign Industry Should Organize

Electric Advertising Gave Place to Other Fads—Can Come Back Now—Work to Be Done in Standardizing Ordinances

BY O. D. ZIEGLER
Vice-President Reynolds Electric Company, Chicago

SPEAKING from the standpoint of a manufacturer who has dealt with the electric sign industry for a good many years, I wish to call attention to the advisability, or rather the necessity, of some kind of a national organization among electric sign manufacturers throughout the United States and Canada. It seems to me a matter of considerable importance.

The electric sign was one of the very earliest direct applications of electric service other than for light or power. It was one of the first pieces of electrical merchandise that the central-station company had to sell, and as early as 1900 it had come to a high degree of perfection. From then until, say, 1908, the development of an electric sign load was looked upon as one of the greatest opportunities for the upbuilding of central-station business. "White ways" were in the making in many cities, slogan signs were being erected by the power companies to advertise the cities they served, and we were manufacturing flashing devices at that time almost as complicated as those in use on the largest sign displays of today.

But the sign business lost its place in the center of the stage when other appliances came along and became fads with the industry. The electric flatiron, the vacuum cleaner, the clothes washer each in turn won the enthusiastic attention of the central station, and the fact that the sign still offers one of the most profitable loads that may be put upon the station today, when the high peak load is no longer a menace in many cities, has been forgotten.

BUSINESS VERY LARGE

Under these conditions the electric sign industry itself has more than once been through hard times. A large number of manufacturers have come into existence, for the most part doing a purely local business. The actual volume of electric sign business has grown to very large proportions until the annual sales are estimated to total about sixty million dollars, including displays and flashers. It has grown because electric sign advertising has demonstrated itself to be one of the most profitable forms of publicity, and without any consistent support from the light and power companies it has kept on increasing. But individual manufacturers have operated every man for himself, and destructive price competition has taken a heavy toll.

The need for an association of some kind is therefore emphasized by the woeful lack of co-ordination

among the manufacturers themselves, and at the same time the lack of co-operation on the part of the central stations due to the lack of any common purpose or guiding standard policies. The result of it all is that there has been little real prosperity among the sign manufacturers, and lacking this no one could take the active lead in the promotion of the sign idea on a national basis and develop the electric sign to the place in this industry that it deserves.

ORDINANCE SITUATION

Another and big advantage which will inevitably come with organization would be in the standardizing of the various city ordinances pertaining to the construction, hanging and installation of electric signs. Almost every town now has its own version as to how the electric sign business should be handled or mishandled. A concerted effort on the part of a national organization, supported by the influence of the central station, would bring about a more uniform and healthier condition in cities where ordinances are unfavorable toward the installation of electric signs.

The electric sign ordinance bugaboo is in evidence in nearly every town. There are restrictions and restrictions and still more restrictions, and the result is that the sign industry suffers, together with all the manufacturers of materials, such as lamps, wire, receptacles, flashers, and so on, to say nothing about the central station. It is therefore easy to see that an organization could not fail to do a great deal of good. It is self-evident that occasional meetings would bring about a better understanding and a kindlier feeling among men engaged in the same line of endeavor. There are possibly 125 companies, partnerships and individuals throughout the United States and Canada that should be members of an organization of this kind. I am sure that there is not a central station, lamp company or dealer in sign materials, such as sheet metal, wire and general supplies, who would not favor an association of this kind and, furthermore, who would not give it wholesome support.

An organization among the electric sign manufacturers would undoubtedly put the industry on a higher plane and eliminate most of the cutthroat competition, as the various manufacturers could be brought together for an exchange of ideas, such as the manner of handling accounts, cost systems, wage scales and a great many items which help retard progress. The final result would be a better and healthier business condition and a happier and more contented feeling all the way around.

LARGE LOAD WAITING

The electric sign has come to stay. We shall see larger signs and more brilliant displays in corresponding greater numbers in the future than we do today. The industry is growing by leaps and bounds even under the restrictions of disorganized price competition, and there is no reason why all of us cannot share in the prosperity instead of only a few. I believe that there could be no better time for the move to be made than right now, for the reason that there has been a revival of interest in the possibilities of electric sign load among electric light and power men in the last year. It is beginning to be recognized that here is a very fundamental market for energy that has not had much attention for fifteen years. It should be easily possible for the electric sign industry to get together and resell the electric sign idea in a big way, restoring this branch of the business to a position of no less prominence and profit than it enjoyed in the old days.

Business Conditions

THE volume of business transacted is showing a steady upward movement throughout most sections of the country. While this is a normal fall increase in demand, coming as it has after a period of reduced activity, it is indicative of a healthy general condition. Buyers are showing more confidence in the market, and electrical men express the belief that present sales will not only continue but increase in volume. A million-dollar order has just been reported by the Westinghouse Electric & Manufacturing Company for railroad electrification equipment. A manufacturer of electrical instruments reports that total sales for the whole country to September 1 are equal to those of last year for the same period. It is noticeable that the manufacturing trend has been steadily toward a reduction of costs by the installation of more efficient machinery.

In New England jobbers report better business with gains small and competition acute. Retail trade is spotty in this district, but a large syndicate reports a steady gain each week in the combined appliance sales of ten central stations. Industrials are becoming more active in the New York district, and sales of supplies are steadily improving. In the Southeast business is considered satisfactory and shows some improvement, but retail trade is off. Good range sales are reported in this territory, especially of hotel cooking and restaurant equipment. Business has increased in the Middle West and utility construction work is active. On the Pacific Coast September sales have failed to show an expected improvement owing largely to decreased business from railroads and power companies.

Canadian Electrical Industry Active

SALES for the first six months of 1924 are well ahead of the same period in 1923 and considerably ahead of the first half of 1922, according to a statement issued by W. O. Taylor, sales manager of power-plant equipment for the Northern Electric Company, Montreal.

"A large proportion of the trade, of course, is coming from hydro-electric development work," says Mr. Taylor. "Independent power companies, lighting systems and general industry have been steadily placing orders. The Middle West territory is improving. The Alberta coal fields have been buying considerable quantities of motors, indicating apparatus, etc., and would have spent more money had it not been for strikes. The Ontario mining fields have produced considerable business. We have recently made some large installations. Quebec territory is producing good business, although the mining districts are not yet far enough advanced to buy much equipment.

Electrical Delinquent Accounts Lower

REPORTS of delinquent accounts for August, 1924, sent in to the National Electric Credit Association indicate that the number of such accounts

DELINQUENT ACCOUNTS IN AUGUST

Branch and Month	Number of Accounts Reported	Total Amount	Average Amount
Central Division:			
July, 1923..	724	$91,394.71	$126.23
July, 1924..	885	107,773.30	285.79
August, 1923..	739	114,261.15	154.61
August, 1924..	935	109,854.37	117.49
New York:			
July, 1923..	404	61,434.00	152.00
July, 1924..	356	60,164.00	170.00
August, 1923..	380	70,770.00	186.00
August, 1924..	301	49,874.00	167.00
Philadelphia:			
July, 1923	238	20,651.30	86.77
July, 1924..	270	30,596.62	113.32
August, 1923..	176	20,660.96	117.39
August, 1924..	244	24,207.92	99.21
New England:			
July, 1923..	26	3,062.32	117.78
July, 1924..	112	10,683.63	95.40
August, 1923..	54	5,117.10	94.76
August, 1924..	55	9,953.40	180.97
Pacific Coast:			
July, 1923..	36	7,992.57	222.01
July, 1924..	19	616.00	32.42
August, 1923..	17	2,583.80	151.99
August, 1924..	15	2,564.12	170.94

for that month is lower than it was in July. In the central division, however, during this period delinquent accounts increased from 885 to 935, although the average amount decreased from $285.79 to $117.49. In New York and Philadelphia the July delinquent accounts and the average amount were greater than in the month following. In New England and on the Pacific Coast the number was lower in August than it was in July, but the average amount increased.

A comparison between August, 1924, and August, 1923, indicates that the number of accounts is rising, although the average amount is lower. The complete list is given in the table on the preceding page.

Mexico Ready for United States Business

THERE seems to be no reason why American exporters cannot do business in Mexico with just the same assurance of success as they have in the United States and with no more hazard of bad debts than they would have at home if they take the same precautions in dealing with new customers that they would take at home and utilize the existing Mexican avenues of obtaining the necessary credit information, said Calvert Townley, assistant to the president of the Westinghouse Electric & Manufacturing Company, who has just returned from Mexico with a delegation of 50 prominent American manufacturers representing the American Manufacturers' Export Association.

Europe has been very much in the thoughts of American business during the past few years, according to Mr. Townley, and Mexico has received little attention. Yet Mexico is a country of vast natural resources; she is in geographical contact with the United States; the United States is her best customer, and there is every reason why we should supply her with practically everything she does not produce herself.

"All Mexico is now at peace and there is not even the shadow of a minor revolution on the horizon," stated Mr. Townley. "The national government is constructive and is devoting 65 per cent of the annual budget to education. In striking contrast to Europe, Mexico has no paper money, gold coins being the standard of exchange. Continuous, all-pervading courtesy is certain to be extended to every American who deserves it.

"Electrical development in Mexico is well under way. The country has abundant water power, together with vast resources of coal and oil, so that there is every reason to look for a nation-wide system here in time. The electric system in Mexico City is modern in every respect, and electric cooking and house heating is coming into general use.

"All of the cities that were visited en route had electric light and power plants, and a division of 28 miles over a heavy mountain grade on the main line of the railroad to Vera Cruz has been electrified. The waterworks of Mexico City are electrically operated, the pump motors being of 1,250 hp., the largest in Mexico, and electric power is used in the majority of factories within the reach of power lines. Electrical manufacturers will certainly find the Mexican market of constantly increasing importance.

"Radio is as popular with the Mexicans as it is with us, and an excellent business is being done in receivers, especially of the higher grades to bring in the large United States stations. A local station provides opportunity for the sale of small outfits also."

Non-Ferrous Metal Market Very Quiet—Nickel Advances

THE non-ferrous metal market has been exceedingly quiet during the past week, being one of the dullest on record. The absence of substantial buying in copper was particularly noticeable. However, lead has continued strong and a new price has been established for nickel—the first change on record for several months.

Little copper was sold during the week, although several inquiries were received. The market cannot be called weak; the present situation being due both to the action of the producers in not pressing sales and to the consumers in not being anxious to buy. Some sales were made at 13 cents per pound, but copper can generally be secured at 12¾ cents per pound. Foreign orders have been fair.

NEW YORK METAL MARKET PRICES

	Sept. 24, 1924 Cents per Pound	Oct. 1, 1924 Cents per Pound
Copper, electrolytic	12.975	12¾
Lead, Am. S. & R. price	8	8
Antimony	11½	11½
Nickel, ingot	27½	29
Zinc, spot	6.45	6½
Tin, Straits	47½	48½
Aluminum, 98 to 99 per cent	28	28

Lead remains firm and not only shows no weakness but has many elements of strength. The official contract price of the American Smelting & Refining Company continues at 8 cents. The foreign market is very strong. Domestic sales have been fairly heavy but the market has been quiet since Monday.

Zinc has been steady, with domestic consumers taking only a slight interest in the market, but the interest from abroad has kept the price from declining.

As the price of tin here has been below the import cost, London dealers have been purchasing in the United States. This has helped to stabilize the market. Domestic demand has been light.

Gradual Improvement Continues in New England

WHOLESALERS in the New England district report better business from week to week, although gains are small and sales competition is acute. An open fall with protracted good weather has helped the building industry and electrical contractors are purchasing consistently. Wiring supplies are moving well, but prices are unsteady in wire, with frequent ups and downs as close bidding develops. Radio sets and supplies are moving faster, and deliveries are beginning to be longer on the higher-grade material. The electrical retail trade is spotty, but one large syndicate reports a steady gain each week in the combined appliance sales of ten central stations.

Electrical machinery makers are running considerably under capacity, but a large amount of prospective business is in sight and central-station growth goes on apace. Electrical manufacturers declare that wages in some cases are at the war peak and that, while raw materials are lower, some readjustments in payroll are inevitable as time passes. Interest in street lighting was enhanced this week by the program of the American Society for Municipal Improvements, which met at Boston in convention and held a session at the Lynn works of the General Electric Company to discuss this topic.

Sales in Southeast Satisfactory—Retail Trade Off

BUSINESS continues to improve in the Southeast, although the past two weeks of inclement weather have served to slow up retail trade. Electrical jobbers report central-station purchases as very satisfactory, but sales to contractors are quiet and purchases of all types of heating devices by the trade generally are very good. One large manufacturer's representative states that its range sales are 25 per cent ahead of those this time last year and that hotel cooking and restaurant equipment business is 200 per cent better than a year ago. This latter fact is the reflection of the large amount of hotel construction that has been undertaken in this section during the past year.

The demand for residential lighting fixtures is steady, and the sale of the commercial type has been considerably stimulated by central-station campaigns during September. Projected campaigns for the month of October should sustain the present volume. Industrial lighting equipment is selling satisfactorily. Inquiries for high-tension equipment are on the increase, and while sales are still somewhat below the usual fall volume, indications are that the market will be more active within the next sixty days.

Industrials Active in the New York District

MANY industrials in the New York district are now proceeding with work which was originally planned several months ago. This activity is not confined to any particular industry but is more or less general. Central-station activity in the purchase of supplies in connection with new power stations has materially helped sales. Activity is also noticed in the summer-resort sections, and there has been a good demand for guy anchors and cross-arms. Meter transformer and auxiliary equipment business continues very active, the volume this year of a large manufacturer, being in excess of that for last year for the same period. A company making

electrical instruments reports sales in this district as one-third more up to September 1 than for the same period last year, due largely to increased interest by utilities in voltage regulation. No curtailment in sales of this class of material is expected as long as the present building program continues. Negotiations which have been opened up by utilities for generating equipment for new projects are now active to a point where they will soon be closed.

Jobbers report that sales are steadily improving. This is a normal fall condition, but taking place as it is after a period of slackened business, it has proved that general conditions are healthy. Lamps are moving faster with the shortening of the daylight period, and washing-machine sales are reported by a large jobber as very good. Radio is showing a good improvement. Prices are in general holding firm.

Increased Business Activity General in Middle West

INCREASED activity has characterized the Middle Western markets, the better general outlook having a noticeable effect on business. Utility construction work is being advanced as fast as materials are obtained. Central-station purchases were heavier, particular attention being given to bus-bar copper, weatherproof wire and a quarterly supply of solder. The demand for alternating-current meters is exceptionally brisk in Chicago, as the new customers to be connected have increased materially in the last ten days. The demand for high-tension equipment remains strong, although manufacturers' representatives admit that more business could be accepted. Motor sales have accelerated and several large installations are in view.

A considerable volume of business has been obtained in industrial heating apparatus. So far this year, the volume of sales in this particular line exceeds last year's figures and there is every prospect of it continuing to do so. Appliance sales were very encouraging, particularly in electric heaters. Prices remain generally firm, with an upward trend indicated. Copper, however, dropped ½ cent per pound September 23, with a corresponding reduction in code and magnet wire. From all indications, conduit prices will remain at the present card.

September Sales Disappointing on the Pacific Coast

SEPTEMBER sales in general have been rather disappointing in the southern section of the Pacific Coast, for they failed to show the expected improvement which usually makes the last four months of the year exceed their proportion. This has largely been due to decreased business from railroads and power companies, for electrical contracting business has been good with many fairly large orders for construction material. Motor sales have been poor, with a marked decline in the number of inquiries. Export business has lately produced several good stock orders for supplies for shipment to Central America, but no general improvement has yet been manifested. Among the larger orders reported are a two-thousand-dollar request for steel reflectors, about $10,000 worth of porcelain insulators, two carloads of pole-line hardware and 165 miles of No. 4 copper wire for a 55-mile power line.

A reduction of 10 per cent in the price of outlet boxes was made in the northern section of the Pacific Coast. Household appliances, including washing machines and ranges, are selling in better volume in this section than at any time during the year. Electric heaters are not moving so actively as predicted, owing to mild weather. A continued slight decrease is noted in the volume of housewiring devices and schedule material that is sold. Sales of hydro-electric equipment predicted have not yet materialized.

Activities of the Trade

Westinghouse Gets Million-Dollar Order for Railroad Electrification

The Westinghouse Electric & Manufacturing Company announces the receipt of orders totaling approximately $1,000,000 for apparatus to be used in connection with the ten-million-dollar electrification which the Baltimore & Ohio Railroad is carrying out on Staten Island.

The Westinghouse contracts cover five automatic substations with supervisory control for the Staten Island Rapid Transit Company and high-voltage equipment for the Staten Island Edison Corporation, which will supply the power for operating the railway. Each of four of the substations will contain two 1,000-kw. rotary converters with the necessary auxiliary apparatus, and the fifth will contain a single converter of the same size.

Rockbestos Corporation to Open Own New York Sales Office

The Rockbestos Products Corporation, Canner & Nicoll Streets, New Haven, Conn., will open its own sales offices at 5942 Grand Central Terminal Building, 70 East Forty-fifth Street, New York City, about November 1. The establishment of this sales office is to give the company a better opportunity to serve its customers in this district. Harry B. Hammond will be in charge of the office as New York representative, and in addition to the metropolitan district the territory covered will include eastern New York State, New Jersey, Delaware, Maryland and eastern Pennsylvania.

Mr. Hammond was formerly connected with the Westinghouse Electric & Manufacturing Company and recently has been metropolitan sales manager for Johns-Manville, Inc.

R. C. Maxwell Company Receives Large Sign Order

The R. C. Maxwell Company, 413 East State Street, Trenton, N. J., has received an order from the Westinghouse Electric & Manufacturing Company for an electric sign which, it is said, will be the largest in the world when completed. A steel structure 250 ft. long and 50 ft. high to carry the sign is now under construction on the new Westinghouse building at Thirtieth and Walnut Streets, Philadelphia. Some idea of the size of the letters is indicated by the fact that the "W" is 27 ft. high by 36 ft. long, about twice as long and twice as high as the average freight car.

Over 50 tons of steel are being put into the frame to hold the sign, and about 5,000 Westinghouse daylight lamps will be used for illumination. The sign and flasher are so constructed that it will be possible to use any size of lamp from 10-watt to 50-watt if desired. It is expected that the sign will be in operation in about thirty days.

Johnston Patent on Seam Welding Upheld by Court

The Johnston patent Nos. 1,388,434 and 1,435,306, one on the method of welding butt-seamed steel tubing and the other on the product, owned by the Elyria Iron & Steel Company of Cleveland, were upheld by Judge Garvin in the Eastern District United States Court in Brooklyn, N. Y., where an injunction and accounting were granted on August 26. Suit was brought by the Elyria company against the Mohegan Tube Company to restrain the latter from welding a tube having what the Elyria company calls its characteristic "alternating-current stitch-weld seam." During the course of the trial Judge Garvin made several attempts to get the parties to come to an agreement, but was unsuccessful. An appeal of the decision will be made.

General Electric Sheath Wire Patents Sustained by Courts

A patent covering what is known as "sheath wire" for use in electric heating apparatus and appliances has just been sustained by the Circuit Court of Appeals for the Seventh Circuit in a suit brought by the General Electric Company and the Edison Electric Appliance Company, Chicago, against the Cutler-Hammer Manufacturing Company of Milwaukee, and an injunction and accounting has been ordered. This affirms the decree of Judge Geiger in the District Court at Milwaukee, before whom the case was originally tried.

The invention upon which the suit was brought was made by Charles C. Abbott of the Pittsfield Works of the General Electric Company and is covered by patent 1,367,341, dated February 1, 1921. The Cutler-Hammer Company brought a counter claim under a Schneider patent held by it, but the court held that the Abbott patent was valid and was infringed.

The **General Electric Company** during the "All New England Week" from September 15 to 20, when products made in the New England States were boosted, exhibited on a main city square in Pittsfield, Mass., a 5,000-kva. self-cooled power transformer. The transformer, measuring 21 ft. above the pavement, made a very effective exhibit both on account of its size and its unusual aspect.

The Wagner Electric Corporation, St. Louis, announces that its New York service station has been removed since October 1 to larger quarters at 321 West Fifty-fourth Street. P. K. Winter continues in charge as service manager.

The Timer Guild, Inc., 8 West Fortieth Street, New York, has been organized for the manufacture of time-controlled devices. Raymond D. Smith, president of the Tremont Products Company and formerly president of the Howard Time Appliance Company, Boston, is president, and E. Cantelo White, president of the Tork Company and the Electric Outlet Company, New York, is treasurer.

The Dubilier Condenser & Radio Corporation, 48 West Fourth Street, New York, is said to have preliminary plans under consideration for plant enlargements, to include the arrangement of facilities and additional equipment for extensive increase in production.

The Westinghouse Electric & Manufacturing Company has expanded its group insurance program with the Metropolitan Life Insurance Company to include 2,000 employees for a coverage of $4,000,000, thus bringing the total of the Metropolitan group insurance on Westinghouse workers to more than $15,000,000.

The Sessions Engineering Company, 208 South La Salle Street, Chicago, consulting engineer, has opened a Western district office at Portland, Ore., in charge of H. F. Winte, Suite 1238, Northwestern Bank Building.

The F. W. Wakefield Brass Company, Vermilion, Ohio, manufacturer of "Red Spot" electric lighting specialties, announces the appointment of Herbert W. Wilson, who will have charge of trade development work with jobbers. Mr. Wilson was formerly with the Erner Electric Company, a jobber of Cleveland, and for the last year has been specializing in commercial lighting work.

The Mueller Electric Company, 1583 East Thirty-first Street, Cleveland, announces that it is now manufacturing a "Universal" test clip fitted with a readily renewable steel needle which can be used to pierce the insulation of a wire and make contact with the conductor.

The Hoover Company, North Canton, Ohio, manufacturer of vacuum cleaners, is inclosing in every package shipped from its factory a four-page folder briefly picturing the comforts of electrical service and suggesting the support of the local electric light and power company by investment in its securities.

The Black & Decker Manufacturing Company, manufacturer of electric drills and machinery, has filed plans for the erection of an addition adjoining its present plant, on Joppa Road, Baltimore, to cost $60,000.

The Scofield-Hendricks Company, jobber, has moved from 61 to 26 Allyn Street, Hartford, Conn.

The Roller-Smith Company, 233 Broadway, New York, announces the appointment of the Thrall Electric Company, Presidente Zayas No. 27 and Esquina A Habana, Havana, Cuba, as its exclusive representative for the island of Cuba. The Thrall company, primarily a sales and engineering organization, representing a number of companies and carrying a complete stock of electrical machinery and supplies, will carry a comprehensive stock of Roller-Smith instruments and circuit breakers.

The Trumbull-Vanderpoel Electric Manufacturing Company, Bantam, Conn., manufacturer of safety switches, panelboards, etc., announces the appointment of the H. Lee Reynolds Company as its representative in the Pittsburgh territory. This territory includes Pennsylvania west of Altoona and the northern part of West Virginia.

The Kellogg Switchboard & Supply Company, Adams and Aberdeen Streets, Chicago, manufacturer of telephone systems and apparatus, announces the promotion of Harry N. Farris, former sales representative for Kansas, to the position of Southwestern district manager, with offices at the Kansas City branch of the company. The promotion of H. A. White to Southwestern sales manager is also announced.

The Reynolds Electric Company, 2650 West Congress Street, Chicago, manufacturer of fractional-horsepower motors and motor-driven appliances, etc., recently completed an electric sign flasher of unusual size, incorporating the company's latest method of transmission by means of spur gears. The motor on this flasher is also equipped with an idler pulley to take up the slack in the belt.

The Electric Outlet Company, 8 West Fortieth Street, New York, has taken over the marketing of "SRK Wire Connectors," which are now sold as "SRK Wire Nuts." These wire nuts may be used on solid or stranded wires without twisting the wires and will not cut stranded wires.

The Howard-Geeseka Advertising Agency, Minneapolis, announces its removal from the Plymouth Building to 1008 Marquette Avenue, in order to obtain larger floor space and better facilities.

The Bryant Electric Company, 1421 State Street, Bridgeport, Conn., manufacturer of electrical specialties, has recently placed on the market a combination bakelite pendent switch and appliance outlet for use in connection with lighting fixtures which are out of convenient reach. This new device is known as catalog No. 29081.

The Kehoe Company, Toledo, Ohio, is now placing on the market a new electric dishwasher, known as the "Kehoe," that utilizes the centrifugal-force principle.

New Equipment Available

Electric Heating Machines

Two types of heating machines for the heating of metals by electric current preparatory to brazing and soldering have been developed by the Gibb Instrument Company, Bay City, Mich. One of the machines was developed to solve the problem of brazing a flange to a tube and proved itself both faster and cheaper. The other machine was designed for the heating of metallic screen frames for the purpose of instantly flowing solder the entire length of the frame into the corner where the metal strip ends meet.

A specially built transformer is provided for supplying the necessary low voltage and high amperage required. A six-point switch is used in the circuit to regulate the heat in accordance with the size of the work.

Permeameter

A permeameter of the laminated-yoke type for the routine industrial determination of the inherent magnetic properties of materials, and employing the ballistic method of measurement, has been developed by Frank P. Fahy, 50 Church Street, New York. It is known as the "Fahy Simplex" permeameter and affords ready means for varying the sensitivity of the apparatus to meet a wide range of daily industrial testing as well as research work. Companion specimens or compensation adjustments are not required, and it is said that the presence in the test material of purely local inhomogeneities will not cause incorrect conclusions as to the magnetic quality of the material.

The Simplex permeameter accommodates solid or laminated specimens up to 2 in. x ¾ in. in section and of any length from 10 in. upward, and contact bushings are provided to permit testing ½ in. rods. The method used in determining permeability or any points on the normal induction curve is analogous to the determination of electrical resistance by the drop-of-potential method.

Indicating Pyrometer. — A high-resistance indicating pyrometer, for wall or switchboard use, and known as Model 420, has been placed on the market by the Bristol Company, Waterbury, Conn. The instrument contains a high-resistance Weston millivoltmeter for the measuring element and as a part of the standard equipment is furnished with a Bristol patented automatic internal-cold-end compensator so that no allowance for correction of readings is necessary. The instrument can be furnished for all ranges up to 3,000 deg. F.

New Trade Literature

INDUSTRIAL ELECTRIC TRUCKS.—The Yale & Towne Manufacturing Company, Stamford, Conn., has issued its first catalog, known as 1-K, of electrical industrial trucks, tractors and trailers. It contains full engineering details and specifications covering its line of trucks, with valuable suggestions bearing upon storage-battery charging equipment and notes upon the designs adopted for trucks of varied types and applications.

GRAPHIC METERS.—Bulletin No. 724 issued by the Esterline-Angus Company, Indianapolis, calls attention to some recent improvements in the "Esterline-Angus" meter clock. The graphic kva. meter which is used to study the subject of kva. demand rates and for measuring the loads of consumers billed under a power-factor clause is also described and illustrated in this bulletin.

APPRAISAL SERVICE.—"The Property Owner's Handbook" is the title of a booklet issued by the American Appraisal Company, Milwaukee, in which it seeks to set forth a number of the auxiliary uses, gathered from the company's contact with its clients, of appraisals as practiced by manufacturing concerns, natural resource properties, public utilities, etc.

FANS.—Bulletin No. 1,103 issued by the American Blower Company, Detroit, describes and illustrates the American "H. S." fans. It gives the characteristic curves of the fan, and several pages are devoted to tables showing the capacity of the various sizes and dimensions of apparatus and size of air ducts.

ELECTRIC APPLIANCES.—The Edison Electric Appliance Company, Inc., 5,600 West Taylor Street, Chicago, is distributing a new catalog supplement covering new "Hotpoint" labor-saving developments in 1924, including waffle irons, duplex grills, "C-9" and "C-7" cookers, "Headlite" heaters, etc.

STOKERS.—The Illinois Stoker Company, Alton, Ill., has issued a new catalog, covering Illinois chain-grate stokers with dampered air control, embodying a complete discussion of both the type A, natural draft, and the type G, forced draft. A series of blue-print drawings illustrate the use of both forced-draft and natural-draft Illinois chain grate stokers in connection with all the principal types and makes of boilers. The text is explicit and also deals with the advantages of mechanical stoking as well as the air control feature of Illinois chain-grate stokers.

SYSTEMS FOR THE AUTOMATIC CONTROL OF COMBUSTION.—The Carrick Engineering Company, 138 South Clark Street, Chicago, has issued a bulletin giving the complete specifications, together with diagrams and list of equipment required for thirty-three distinct methods of automatically controlling boiler-room equipment. The bulletin has been prepared primarily for consulting and designing engineers. Thirteen different methods of controlling powdered coal are included.

POWER.—The Morse Chain Company, Ithaca, N. Y., has issued a booklet entitled "Power, Its Application from the Seventeenth Dynasty to the Twentieth Century," an address given by F. L. Morse at the twenty-sixth annual convention of the American Mining Congress at Milwaukee, Sept. 27, 1923. It also contains many illustrations showing the devices used by various countries from the first records of civilization to the present time.

ELECTRIC LAMPS.—The Aladdin Manufacturing Company has issued catalog No. 24, showing the entire line of "Aladdin" lamps, including desk lamps, piano lamps, floor lamps, table lamps, etc.

RESISTOR UNITS.—The Monitor Controller Company, Baltimore, is distributing a bulletin covering the "Monitor Edge-wound" resistor units.

Foreign Trade Opportunities

Following are listed opportunities to enter foreign markets. Where the item is numbered, further information can be obtained from the Bureau of Foreign and Domestic Commerce, Washington, by mentioning the number.

An agency is desired in Bahia, Brazil (No. 11,751), for electrical supplies and radio sets and parts.

Purchase is desired in Sydney, Australia (No. 11,748), of radio sets and parts.

An exclusive agency is desired in Melbourne, Australia (No. 11,749), for radio sets and parts.

Purchase and agency is desired in Madrid, Spain (No. 11,750), for tungsten thorium filaments.

ELECTRIC POWER PLANT FOR GREY, NEW ZEALAND.—Tenders will be received by the Grey Electric Power Board, Grey, New Zealand, until Nov. 14 for a steam-driven electric generating plant.

BATTERY CHARGING MOTOR-GENERATORS FOR NEW SOUTH WALES (AUSTRALIA) GOVERNMENT RAILWAYS.—Tenders will be received by the New South Wales Railway Commissioners, Sydney, Australia, until Oct. 29 for two battery-charging motor-generators and two electric storage batteries.

New Incorporations

THE VAN ACKEREN HYDRO POWER COMPANY, Cedar Rapids, Neb., has been incorporated by A. J., Paul V. and G. M. Van Ackeren of Cedar Rapids. The company is capitalized at $10,000 and proposes to purchase the plant owned by the Van Ackeren brothers.

THE SOUTHEASTERN POWER & LIGHT COMPANY has filed articles of incorporation at Augusta, Me., for the purpose of purchasing and dealing in electric light and power plants. The capital consists of 600,000 shares of stock of no par value. E. M. Leavitt is president and Frank E. Southard treasurer and clerk.

THE MOUNTAIN GROVE (MO.) POWER COMPANY has been incorporated with a capital stock of $10,000 by R. D. Alexander, 1089 South Boulevard, Springfield, Mo.; L. H. Williams and W. M. Williams, Mountain Grove.

THE NAPOLEON (IND.) LIGHT & POWER COMPANY has been chartered with a capital stock of $10,000. The directors are E. A. Behlmer, Henry Hunger, J. A. Meyer, F. J. Grow, J. F. Stevenson, G. C. Taylor and F. M. McClanahan.

Construction News

Projects, Plans, Bids and Contracts, Contemplated or Under Way

New England States

SKOWHEGAN, ME.—The Moosehead Paper Company contemplates the installation of electric power equipment in connection with proposed extensions and improvements at its local mills.

WORCESTER, MASS.—The Fire Department has plans under way for the erection of a fire alarm and telegraph central station, at Newton Hill, to cost about $100,000. L. W. Briggs, 316 Main Street, is architect.

PROVIDENCE, R. I.—Bids will be received at the office of the Water Supply Board, City Hall, until Oct. 8 for equipment for purification works, including indicating and recording apparatus and rate controllers, electrically driven centrifugal pumps, etc. Frank E. Winsor, 661 Westminster Street, is chief engineer. Specifications may also be obtained at the office of Hazen & Whipple, 25 West Forty-third Street, New York City.

WATERBURY, CONN.—The Connecticut Company is building a car house, administration building, salt and sand house, paint shop and garage for its buses instead of a power plant, as reported in the issue of Aug. 30. The construction of a heating plant to supply steam for the above buildings is under consideration by the company. Charles R. Harte is construction engineer, and Haus R. Stamm is architect, both of New Haven.

Middle Atlantic States

CANTON, N. Y.—The Village Board is considering extensions to the electric lighting system throughout the village.

CATTARAUGUS, N. Y.—The Cattaraugus Electric Light & Power Company has applied for permission to extend its lines in the town of New Albion and exercise a franchise granted by the Town Board. Permission has been granted the company to erect transmission lines and an electric distribution system in the towns of Otto and East Otto and exercise franchises granted by the Town Boards.

CHATHAM, N. Y.—Permission has been granted the Chatham Electric Light, Heat & Power Company to extend its electric service into portions of the towns of Canaan, New Lebanon and Stephentown. Electricity will be obtained from a substation of the Albany Southern Railroad Company, to be located at Brainard.

CORNING, N. Y.—The installation of an ornamental lighting system is under consideration by the City Council.

DUNKIRK, N. Y.—The City Council is considering extensions to the street-lighting system in all parts of the city.

GLOVERSVILLE, N. Y.—The Fulton County Gas & Electric Company has applied for permission to erect a transmission line through the town and village of Richmondville and for approval of franchises granted by the town. If granted, the company will erect a 22,000-volt transmission line from Cobleskill to Schenevus with substations at East Worcester and Schenevus. The company has recently taken over the system of the Great Bear Light & Power Company which serves the towns of Worcester, Maryland and Schenevus.

HAMMONDSPORT, N. Y.—The Village Board has granted the Central New York Electric Corporation, Utica, a franchise to generate and distribute electricity in Hammondsport.

HORNELL, N. Y.—Plans are under consideration by the City Council for extensions to the ornamental lighting system throughout the business district. Eventually the entire city will be lighted by ornamental lamps.

ITHACA, N. Y.—The New York State Gas & Electric Corporation is planning to erect a 22,000-volt transmission line from its local steam plant to Spencer, if granted permission to acquire the system of the Seeley Electric Company, which operates in the towns of Spencer, Candor and Van Etten. The company also contemplates extending its lines into the town of Newfield, where it has been granted a franchise. The Public Service Commission has granted the company permission to extend its transmission lines to supply electric service in the town of Rockland, Sullivan County, and in the town of Jefferson, Schoharie County.

JAMESTOWN, N. Y.—Extensions to the street lighting system on North Main Street, Wilson and Prendergast Avenues are contemplated by the Department of Public Utilities. The installation of ornamental lamps on the new Sprague Street Viaduct is under consideration by the City Council.

SULLIVAN, N. Y.—The Syracuse Lighting Company has been granted permission to erect a transmission line and an electric distribution system in a portion of the town of Sullivan.

VERONA, N. Y.—The Adirondack Power & Light Corporation has applied to the Public Service Commission for permission to extend its transmission line to Verona to furnish electric service. The company also plans to light the highway between the town of Sherill and Verona, a distance of 3 miles.

COLUMBUS, N. J.—The Public Service Electric & Gas Company plans to erect a transmission line to Columbus with local distribution system for light and power service.

DOVER, N. J.—The New Jersey Power & Light Corporation has secured permission to issue $694,000 in bonds, $183,500 in capital stock and notes for $76,500, the proceeds to be used to acquire the systems of the Eastern Pennsylvania Power Company, Columbia, and the Vulcan Power Company, Netcong, and for proposed extensions and improvements.

FERNWOOD, N. J.—The Public Service Electric & Gas Company is considering the construction of a local substation. Additional equipment will be installed at the power plant in this section.

NETCONG, N. J.—The New Jersey Power & Light Company has applied for permission to take over and consolidate the plants and systems of the Vulcan Power Company, Netcong, and the Eastern Pennsylvania Power Company, Alpha, Columbia and Phillipsburg. Extensions in the transmission system are contemplated by the New Jersey company.

CORRY, PA.—Plans for the proposed two lumber mills, to cost about $150,000, to be erected by the Little Creek Lumber

Company, Corry, in Greenbrier County, W. Va., include a central power house and electrical equipment for mills.

ERIE, PA.—The City Council plans to build a new low-tension conduit system on Browns Avenue, to cost about $18,000.

LANGHORNE, PA. — The Bucks-Bensalem Electric Company is being organized to construct and operate a light and power system in lower Bucks County. Hause, Evans & Baker, Harrisburg, attorneys are representatives.

LOCK HAVEN, PA.—The New York & Pennsylvania Company plans to install electric power equipment at its local paper mill, in connection with the proposed rebuilding of the plant recently damaged by fire with a loss of about $250,000.

NEWRY, PA. — The Newry Light & Power Company, now being organized, plans to erect a transmission line in this section of Blair County, with local distributing system. The company is represented by James C. Jones, Bullitt Building, Philadelphia.

BALTIMORE, MD. — The Consolidated Gas, Electric Light & Power Company has acquired a site at Thirty-fifth Street and the Old York Road, on which it proposes to erect a substation.

SALISBURY, MD.—The installation of an ornamental lighting system on six blocks in the business section, using 400-cp. lighting units, is under consideration.

RICHMOND, VA. — Improvements are contemplated by the Virginia Railway & Power Company in Richmond and other cities, involving an expenditure of about $274,000. Half this amount will be used in Richmond for improvements which include a small power station in South Richmond.

WASHINGTON, D. C.—Bids will be received by the director of purchases and sales, Department of Agriculture, for one deep well pump, with electric motor, hydropneumatic tank, etc.

WASHINGTON, D. C.—Bids will be received by the director of purchases and sales, Department of Agriculture, Washington, D. C., until Oct. 21 for two vertical-type refrigerating machines of 100 tons capacity each and two synchronous motors of 200 hp., complete with starting equipment.

North Central States

GRAND RAPIDS, MICH.—The Consumers Power Company is considering the construction of a substation on Fulton Street, to cost about $150,000.

MASON, MICH.—The installation of an ornamental lighting system in the business section is under consideration.

CINCINNATI, OHIO. — The Columbia Gas & Electric Company has issued $15,000,000 in capital stock, part of the proceeds to be used for extensions and improvements, including a steam-operated generating station to be constructed near the city at a cost of about $10,000,000.

DELPHOS, OHIO.—Right-of-way is being secured by the Ohio Power Company in Hoaglin and Jackson Townships for a new transmission line which will supply electricity to several villages now without electrical service.

DUNKIRK, OHIO. — The Ohio Power Company, Bucyrus, has been granted a franchise to supply electricity in Dunkirk. Service will be supplied from the transmission line now being erected between Bucyrus and Upper Sandusky.

EUCLID, OHIO. — Contract has been awarded to the Cleveland Electric Illuminating Company for the installation of additional lamps (about 1,300 new lamps of 400 cp.) on Euclid Avenue and Lake Shore Boulevard.

SANDUSKY, OHIO.—The Ohio Public Service Company has applied for permission to take over and consolidate the Sandusky (Ohio) Gas & Electric Company, Northwestern Ohio Railway & Power Company, Port Clinton, and the Port Clinton (Ohio) Electric Light & Power Company. Authority also has been asked to issue $8,000,000 in bonds and $8,177,500 in capital stock to provide funds to finance the project and for proposed extensions and improvements.

FORT WAYNE, IND.—Plans are under consideration by the Board of Public Works for the construction of a municipal power plant on Lafayette Street between Creighton and De Wald Avenues. Charles Brossman, Merchants' Bank Building, Indianapolis, is architect.

INDIANAPOLIS, IND.—The Merchants' Heat & Light Company has been granted permission to issue $260,000 in bonds and $122,000 in capital stock, part of the proceeds to be used for extensions and improvements.

PERU, IND.—The installation of a new electric generating unit in the municipal electric plant, to cost about $60,000, is under consideration.

TERRE HAUTE, IND. — The Indiana Electric Corporation has applied for permission to issue $2,833,000 in bonds and capital stock, the entire proceeds to be used in connection with the proposed superpower generating plant in the Dresser section, near Terre Haute, for which preliminary work is in progress.

EDWARDSVILLE, ILL.—The Western Tie & Timber Company, Syndicate Trust Building, St. Louis, it is reported, contemplates the construction of a power house at its proposed local mill.

ROCKFORD, ILL. — Steps have been taken by local business men to secure a universal ornamental lighting system for the entire city.

WAUKEGAN, ILL.—The Public Service Company of Northern Illinois has applied for permission to extend its transmission system to Spencer Highlands. The company also plans to furnish service to residents along the highways in the vicinity of Channel Lake, Silver Lake and Antiock.

GREEN BAY, WIS.—Steps have been taken by the Northern Paper Mills Company to secure rights-of-way for a tower transmission line from its proposed White Rapids hydro-electric plant and its Green Bay plant.

MADISON, WIS.—The Madison Gas & Electric Company is reported to be considering an auxiliary steam-driven electric plant.

NICHOLS, WIS. — The erection of a 33,000-volt transmission line from Nichols to Bonduel and thence to Shawano, a distance of about 20 miles, is contemplated by the Wisconsin Traction, Light, Heat & Power Company, Appleton. The cost is estimated at $75,000. A substation will be built at Bonduel.

RACINE, WIS.—Plans are under way by the Wisconsin Gas & Electric Company for the erection of a transmission line between Franksville and Husher. Electric service will also be supplied to residents along the line.

WEST SALEM, WIS. — The Neshonoc Light & Power Company plans to extend its transmission lines to Mindoro, a distance of 10 miles. Electricity will also be supplied to residents along the line.

WEYERHAUSER, WIS.—Bonds to the amount of $5,000 have been voted for the purpose of securing the erection of a transmission line from Bruce by the Lake Superior District Power Company, which recently acquired the local plant.

CANNON FALLS, MINN.—The Cannon Falls Hydro-Electric Company will defer until next year the construction of its proposed hydro-electric plant at the Cannon Falls dam. The cost is estimated at $250,000.

FERGUS FALLS, MINN.—The Ottertail Company contemplates building a new dam at Tappan Gorge, 8 miles north of here.

MINOCQUA, MINN.—Negotiations have been completed whereby a transmission line will be erected from the municipal electric plant in Eagle River to Minocqua to supply electricity to the local municipal system. The proposed line will be about 25 miles long, and it is understood, will furnish electrical service to the village of Woodruff and the summer resorts along the line.

WACONIA, MINN.—Plans, it is reported, are under consideration for the construction of a municipal electric light plant, to cost about $50,000.

CARROLL, IOWA. — The Iowa Light, Heat & Power Company has applied for permission to erect additional transmission lines in Carroll, Sac and Ida Counties.

NEWTON, IOWA.—The Iowa Southern Utilities Company plans to erect a 44,000-volt transmission line from Grinnell.

SAC CITY, IOWA.—Application has been made to the City Council by Russell & Fry for a franchise to install a local electric lighting plant.

EVERTON, MO. — The South Missouri Power Company plans to extend its transmission line to furnish light and power service here.

LA MOURE, N. D. — The Otter Tail Power Company, Fergus Falls, is considering the erection of a transmission line from Cogswell to La Moure.

ROSLYN, S. D. — Negotiations are in progress with the Northern Public Service Company for the erection of a transmission line from Summit, via Greenville, and installation of local electric distributing system.

COTESFIELD, NEB.—Bonds have been voted for the erection of a transmission line and the installation of a local distributing system.

SCOTTSBLUFF, NEB.—The Council has approved the installation of additional street lamps on Fifth Avenue between Fourteenth and Eighteenth Streets.

Southern States

BETHEL, N. C.—The Council has issued $25,000 in bonds, the proceeds to be used for the installation of a municipal light and power system.

BOILING SPRINGS, N. C.—The Borough Council plans to issue $12,000 in bonds, the proceeds to be used for the installation of a municipal light and power system.

CHARLOTTE, N. C.—The Providence Road Community, Inc., plans extensions in its transmission line in the Providence Road section. J. C. Reid is president.

ELLENBORO, N. C.—The Town Council has authorized the erection of a transmission line to Mooresboro for local light and power service.

GREENVILLE, N. C. — Bonds to the amount of $25,000 have been issued, the proceeds to be used for extensions and improvements to the municipal light and power system.

LEXINGTON, N. C.—The City Council is arranging a bond issue of $25,000 for extensions and improvements to the electric light and power system.

LUCAMA, N. C.—The Council has issued $15,000 in bonds for the installation of a municipal lighting system.

AUGUSTA, GA.—The City Council has adopted an ordinance providing for leasing of the water power of the Augusta Canal for a period of ten years, beginning March, 1927, to be utilized for the development of hydro-electric power.

WINTER HAVEN, FLA.—The plant of the Winter Haven Electric Company has been acquired by new interests, headed by S. B. Beebe, 314 South Edison Avenue, Tampa. The new owners contemplate improvements and extensions.

COLUMBIA, TENN.—The Southern Cities Power Company has acquired the plant and system of the Columbia Water & Light Company and will consolidate with its properties. Plans are under consideration for transmission-line extensions.

HOHENWALD, TENN.—Plans are under consideration by the Council for the construction of a municipal hydro-electric plant, for which a bond issue is being arranged.

WETMORE, TENN. — The Thompson Power Company has applied for permission to construct and operate a 150,000-hp. hydro-electric plant on the Hiwassee River in Polk and Cherokee Counties, Tenn. Plans are also being considered for a hydro-electric plant on Penitentiary Creek, to develop about 100,000 hp. John L. Williams is secretary.

MOBILE, ALA.—Bonds to the amount of $200,000 has been authorized for the installation of a police and fire-alarm system.

CHENEYVILLE, LA.—Bids will be received by the Mayor and the Board of Aldermen until Oct. 20 for construction of an electric light plant, waterworks and ice manufacturing plant. The project will consist of power house, two crude-oil engines, directly connected to alternators and clutch connection to pump of 500 gal. capacity; poles and line equipment, electric house meters, a 5 ton ice-manufacturing plant, waterworks equipment, etc. Specifications may be obtained from F. P. Joseph, Glenmora, engineer.

McALESTER, OKLA. — The Southwest Power Company plans to erect a 66,000-volt transmission line from McAlester to Atoka, Lehigh, Coalgate, Wapanuck and other points, to cost about $165,000. It is planned ultimately to serve Durant, Hugo, Antlers and then to connect with the transmission line leading to Huntington, Ark., and also with the Texas Power & Light Company on the Red River south of Durant.

TULSA, OKLA. — The Public Service Company of Oklahoma has issued $3,275,000 in bonds, part of the proceeds to be used for the purchase of additional properties in this district and for proposed extensions and improvements.

CRYSTAL CITY, TEX. — Surveys are being made by the Crystal City Electric Light & Power Company for the erection

of transmission lines to furnish electricity to a number of towns in this section. Energy will also be supplied to a number of irrigation plants in the valley of the Nueces River.

DALLAS, TEX. — Tentative plans are under consideration by the Board of Public Works for the construction of a municipal power plant at the Garza Reservoir to supply electricity primarily for street lighting and the municipal buildings. It is intended to carry out the project in co-operation with the Dallas Power & Light Company.

FORT WORTH, TEX. — The Southwestern Power & Light Company has arranged for an additional bond issue of $3,500,000, part of the proceeds to be used for extensions and improvements.

Pacific and Mountain States

OLYMPIA, WASH. — A franchise has been granted by the Commissioners of Thurston County to the Puget Sound Power & Light Company, Seattle, for the erection of a high-tension transmission line from McKenna through Yelm and Rainer to Tenino, where it will connect with the line running from Olympia.

BRANDON, ORE.—The City Council has applied for permission to construct and operate a hydro-electric plant on Willow Creek.

WEST LINN, ORE. — The Crown-Willamette Paper Company is reported to be planning to install electric power equipment in its proposed mill addition, to cost about $150,000.

ANAHEIM, CAL.—The Board of City Trustees has called a special election on Oct. 18, to vote on the proposal to issue $240,000 in bonds for the construction of a municipal electric power plant.

OAKDALE, CAL.—The City Trustees are considering improvements to the street-lighting system.

LOS ANGELES, CAL.—The City Council has authorized the installation of an ornamental lighting system on Adams Street consisting of ninety-five concrete standards. Plans are also being considered for an improved lighting system on Lankershim Boulevard between Ventura Boulevard and Hatteras Street.

MERCED, CAL.—Bids will be received by the Merced Irrigation District, Barcroft Building, until Oct. 16, for two variable-head turbines, complete with governors; two generators, 15,620 kva., 11,450 volts, three-phase, 60-cycle, with exciters; one switchboard, transformers, etc.; four 10,400-kva., 11,000/69,000-volt, water-cooled transformers; four 12,000-amp., 11,000-volt circuit breakers; two fifty-five cell storage batteries, with 5-kw. motor-generator set, and one 120-kva. lightning arrester. Plans are on file at the office of H. P. Sargeant, secretary. R. V. Meikle is chief engineer.

MODESTO, CAL.—The City Council has authorized the purchase of two transformers for municipal service. W. F. McCarton is city engineer.

OAKLAND, CAL.—Steps have been taken by the Uptown Association for a new street-lighting system for Franklin Street.

OAKLAND, CAL.—The City Council has authorized extensions and improvements in the lighting system in the business district, comprising 260 standards mounted with two 1,500-cp. lamps. The cost is estimated at $200,000.

PLACERVILLE, CAL.—Plans are under consideration by the Board of City Trustees for the installation of an improved fire-alarm system.

SANTA BARBARA, CAL.—The Board of City Trustees is considering calling a special election to vote on the proposal to issue $135,000 in bonds for the construction of a municipal electric plant.

COLORADO SPRINGS, COL. — A site has been acquired at the foot of Rio Grande and Las Animas Streets and the Fountain Creek for the proposed municipal steam-driven electric plant. The cost is estimated at about $500,000.

Canada

OLDS, ALTA.—A bylaw has been approved by the ratepayers granting Fred Shackleton of the Olds Electric Company a ten-year contract to supply electricity to the town. Improvements will be made to the system, including a new power plant, equipped with a semi-Diesel engine.

ST. SPEHEN, N. B.—The plant of the Maritime Electric Company was recently destroyed by fire, causing a loss of about $200,000.

Electrical Patents

Announced by U. S. Patent Office

(Issued August 19, 1924)

1,505,933. CONTROL OF ELECTRICALLY PROPELLED VEHICLES; H. C. Hastings, Bugby, England. App. filed Sept. 20, 1922. Driving motors used as generators for braking in case of emergency.

(Issued August 26, 1924)

15,898 (reissue). SYSTEM OF CONTROL; B. O. Austin, Wilkinsburg, Pa. App. filed Oct. 6, 1919. Automatic control of electric railway motors.

15,899 (reissue). ELECTRICAL SYSTEM; F. C. Hanker, Wilkinsburg, Pa., and C. McL. Moss, Pittsburgh, Pa. App. filed Sept. 27, 1916. In which a converter or other similar device is adapted to be automatically started and controlled for the purpose of supplying energy to a circuit under predetermined conditions.

1,505,939. HERMETICALLY SEALED DRY CELL; H. S. Batchelor, New York, N. Y. App. filed June 21, 1921.

1,505,963. AUTOMATIC TELEPHONE SYSTEM; C. E. Lomax, Chicago, Ill. App. filed Sept. 13, 1920.

1,505,990. PASTE FOR STORAGE BATTERIES; T. A. Willard, Cleveland Heights, Ohio. App. filed Feb. 4, 1920.

1,505,998. ENGINE STARTER; S. A. Ellett, Elmira, N. Y. App. filed March 3, 1919. For internal-combustion engines.

1,506,003. THERMOCOUPLE MANOMETER; K. Kambayashi, Kuze-Gun, Japan. App. filed April 29, 1921.

1,506,046. RADIO RECEIVING SYSTEM; W. H. Bullock, New York, N. Y. App. filed Jan. 23, 1923. Having a single energy-absorbing circuit combined with a plurality of detecting circuits, each of which may be tuned for the reception of messages of any desired wave length without affecting the tuning of the others.

1,506,054. TELEPHONE SYSTEM; H. M. Friendly, Portland, Ore. App. filed May 20, 1921. Automatic and semi-automatic systems.

1,506,065. ELECTRIC HEATER AND ITS MODE OF MANUFACTURE; L. P. Hynes, Albany, N. Y. App. filed Jan. 26, 1922. Replaceable heating coil contained in a tube of refractory insulation placed within a ribbed metal tube.

1,506,070. CONTROLLER FOR DIRECT-CURRENT MOTORS; W. H. Leslie, Toronto, Canada. App. filed Oct. 13, 1923. Solenoid-controlled plunger type.

1,506,083. RELAY AUTOMATIC TELEPHONE SYSTEM; R. G. Richardson, Chicago, Ill. App. filed July 28, 1920.

1,506,125. TELEPHONE SYSTEM; C. L. Keddy, Lynn, Mass. App. filed Jan. 5, 1922. With means for notifying operator when subscriber is absent by subscriber manually setting a signal prior to leaving.

1,506,179. DETACHABLE-UNIT CIRCUIT CONTROLLER FOR INTERLOCKING MACHINES; W. K. Howe, Rochester, N. Y. App. filed Nov. 2, 1920.

1,506,180. SPARK GAP; E. S. Humphreys and F. Mattern, Chicago, Ill. App. filed April 28, 1922.

1,506,181. DEFERRED-ACTION DRY BATTERY; A. K. Huntley, Madison, Wis. App. filed April 22, 1921.

1,506,183. ELECTRIC LAMP; L. Kellner, Brooklyn, N. Y. App. filed Nov. 29, 1921. With lock-type base.

1,506,184. SAFETY PLUG AND LAMP SOCKET; L. Kellner, Brooklyn, N. Y. App. filed Nov. 29, 1921. Lock type.

1,506,189. ELECTRIC CELL CONTAINING A SALT INHIBITING THE PRODUCTION OF GAS; A. A. MacKenzie, Fremont, Ohio. App. filed Nov. 4, 1920. Dry cell.

1,506,194. SUPPORT FOR RESISTANCE WIRING; F. W. Moffat, Weston, Ontario, Canada. App. filed Jan. 19, 1924. Support for coiled resistance wiring adapted to permit free radiation.

1,506,196. DRY BATTERY; F. D. Moyer, Fremont, Ohio. App. filed Aug. 25, 1920. Deferred-action type.

1,506,216. STORAGE-BATTERY VENT; R. C. Benner, Bayside, N. Y. App. filed Feb. 2, 1922.

1,506,217. DRY CELL AND PROCESS FOR MAKING THE SAME; R. C. Benner, Bayside, N. Y., and H. F. French, Flushing, N. Y. App. filed June 27, 1922.

1,506,224. CARBURETOR FOR INTERNAL-COMBUSTION ENGINES; L. A. de Becker, St. Margaret's-on-Thames, England. App. filed Sept. 2, 1921. With means for preheating the fuel on starting.

1,506,264. ELECTRIC ALARM; H. W. Steckel, Muskegon, Mich. App. filed July 23, 1923. Remote control for hotel rooms.

1,506,271. LINE SWITCH; J. N. Reynolds, Greenwich, Conn. App. filed April 1, 1920. Telephone switches of the cross-bar type.

1,506,275. PROTECTIVE MEANS FOR ELECTRIC CIRCUITS; G. H. Stevenson, Rye, N. Y. App. filed May 25, 1921. For high-frequency or radio circuits in which vacuum tubes of three-electrode type are employed.

1,506,278. BATTERY; N. D. Sturges, Bellerose, N. Y. App. filed May 15, 1922. Storage multi-cell type.

1,506,281. ELECTRIC FURNACE; T. F. Baily, Alliance, Ohio. App. filed Aug. 28, 1923. Resistance type.

1,506,282. ELECTRIC SHOE; J. Barbieri, St. Vincent de Paul, Quebec, Canada. App. filed Oct. 12, 1923. To generate a current while the wearer is walking.

1,506,284. DISINFECTING DEVICE IN COMBINATION WITH TELEPHONE MOUTHPIECES; W. H. Bennett, Victoria, B. C., Canada. App. filed June 22, 1922.

1,506,297. STORAGE-BATTERY CELL; A. O. Garrett, San Diego, Cal., and C. E. Funnell and W. L. Hoffman, Los Angeles, Cal. App. filed Nov. 4, 1920. With means for supporting the plates.

1,506,302. FLASHLIGHT AND ELECTROLYTIC RECTIFIER; N. M. Hopkins, New York, N. Y. App. filed Dec. 20, 1920. Having a miniature storage battery with means for recharging.

1,506,303. FLASHLIGHT; N. M. Hopkins, New York, N. Y. App. filed Dec. 20, 1920. Having miniature storage batteries.

1,506,304. BATTERY; L. L. Jones, New York, and N. D. Sturges, Bellerose, N. Y. App. filed May 13, 1922. Storage multi-cell type.

1,506,306. ANODE; A. Kirkaldy, Brooklyn, N. Y. App. filed Oct. 16, 1923. Employed in an electrolytic system for preventing corrosion of metallic surfaces in contact with water and other liquids as condensers, boilers, etc.

1,506,307. ELECTRODE; A. Kirkaldy, Brooklyn, N. Y. App. filed Oct. 30, 1923. Means for supporting and retaining in active position an electrolytic system for the protection of condensers, boilers, etc.

1,506,308. ELECTRODE; A. Kirkaldy, Brooklyn, N. Y. App. filed Nov. 20, 1923. For use in an electrolytic system for the protection of boilers, condensers, etc.

1,506,320. HIGH-FREQUENCY ELECTRIC ARC; E. F. Northrup, Princeton, N. J. App. filed July 30, 1919. May be used for electric furnace or illuminating purposes.

1,506,344. VIOLET-RAY GENERATOR; B. F. Jancke, Brooklyn, N. Y. App. filed Jan. 31, 1923. For therapeutic use.

1,506,350. ANTI-THEFT DEVICE FOR AUTOMOBILES; S. M. Kukura, Struthers, Ohio. App. filed Aug. 1, 1921. For locking the several vital parts of a motor vehicle against unauthorized use.

1,506,353. VEHICLE DIRECTION INDICATOR; V. Adamson, Pocatello, Idaho. App. filed April 24, 1923.

1,506,358. SENDING ARRANGEMENT FOR WIRELESS TELEGRAPHY; O. Von Bronk, Berlin, Germany. App. filed Sept. 3, 1921.

1,506,372. SOCKET COVER; M. Klein, New York, N. Y. App. filed Oct. 25, 1920.

1,506,374. STABILIZER; J. C. Lincoln, Cleveland, Ohio. App. filed Aug. 29, 1919. Utilized as an arc control in arc-welding machines.

1,506,377. LAMP AND BASE; J. Mandel, Chicago, Ill. App. filed Jan. 25, 1924.

1,506,378. OPERATING ALTERNATING-CURRENT APPARATUS IN WHICH CAPACITY IS DESIRED; R. D. Mershon, New York, N. Y. App. filed Dec. 6, 1919.

1,506,390, 1,506,391, 1,506,392. BATTERY; N. D. Sturges, Bellerose, N. Y. Where the plates are insulated without employing separators, using instead bands of celluloid or equivalent material wound around the plates.

1,506,403. STORAGE BATTERY; H. J. Baker, Indianapolis, Ind. App. filed March 28, 1923. With means for securing a terminal post to a cell cover.

1,506,406. SLIP REGULATOR FOR ELECTRIC MOTORS; A. E. Carver, Beech Bottom, W. Va. App. filed June 7, 1922. Automatic.

1,506,408. COMMUTATOR; E. Clarke, St. Louis, Mo. App. filed Nov. 23, 1921. For short-circuiting a winding of an alternating-current motor on the occurrence of predetermined speed.

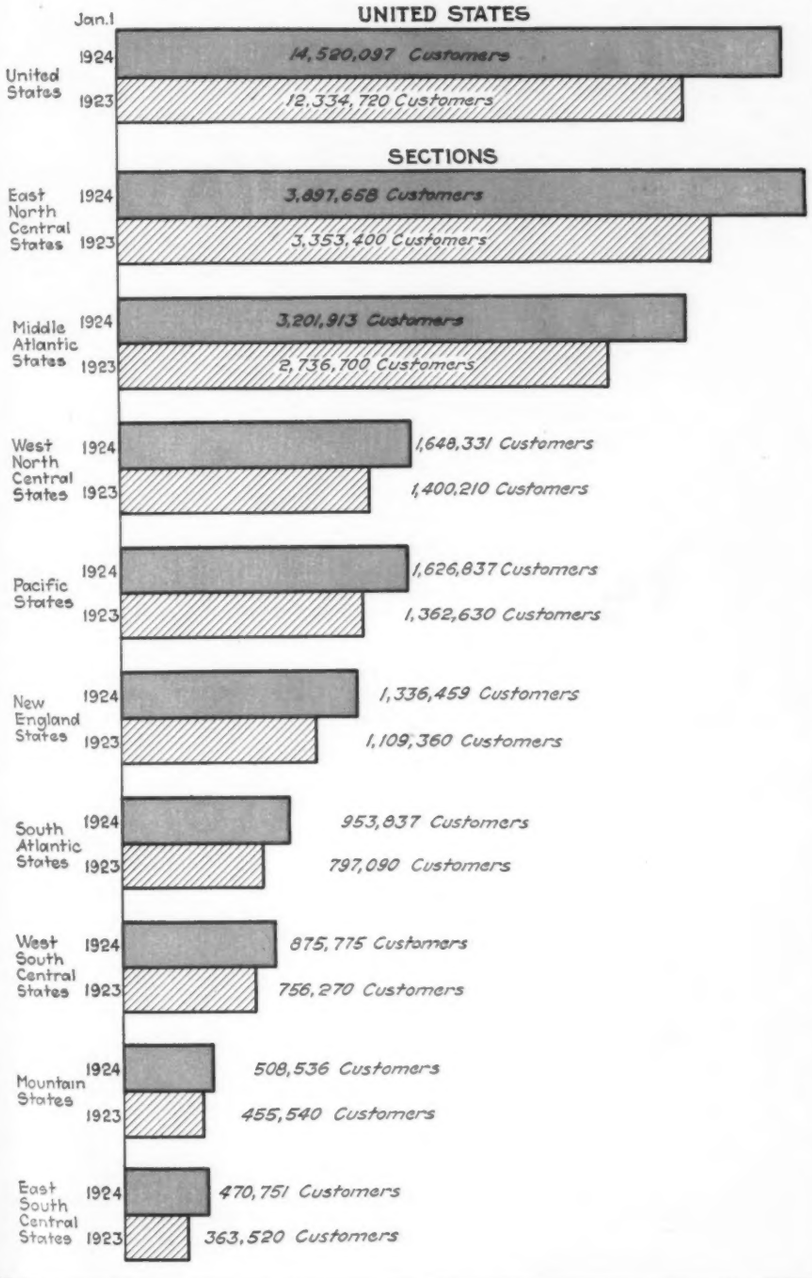
1,506,425. LIBERATION OF OIL FROM OIL-CONTAINING DEPOLARIZERS; G. W. Heise, Elmhurst, N. Y. App. filed May 11, 1922. Primary cells of the zinc-alkali-copper-oxide type.

1,506,443. TEMPERATURE REGULATOR; A. N. Otis, Schenectady, N. Y. App. filed Feb. 25, 1922. For heated apparatus, such as electric furnaces.

Business Facts for Electrical Men

Selected Statistics Presented Graphically for the Use of All Interested in Analyzing the Trend of the Electrical Business

2,185,377 New Customers Added to Central Station Lines During 1923


Jan.1
UNITED STATES
United States 1924 14,520,097 Customers
1923 12,334,720 Customers
SECTIONS
East North Central States 1924 3,897,658 Customers
1923 3,353,400 Customers
Middle Atlantic States 1924 3,201,913 Customers
1923 2,736,700 Customers
West North Central States 1924 1,648,331 Customers
1923 1,400,210 Customers
Pacific States 1924 1,626,837 Customers
1923 1,362,630 Customers
New England States 1924 1,336,459 Customers
1923 1,109,360 Customers
South Atlantic States 1924 953,837 Customers
1923 797,090 Customers
West South Central States 1924 875,775 Customers
1923 756,270 Customers
Mountain States 1924 508,536 Customers
1923 455,540 Customers
East South Central States 1924 470,751 Customers
1923 363,520 Customers

Most of the data for statistics in the ELECTRICAL WORLD are gathered by it from original sources. Privilege is freely given to readers of the ELECTRICAL WORLD to quote for use these statistics for any legitimate purpose. While there is no requirement that the source of data be given, yet it would help the ELECTRICAL WORLD in obtaining and compiling further basic information if those who make use of these statistics would give credit to the ELECTRICAL WORLD.

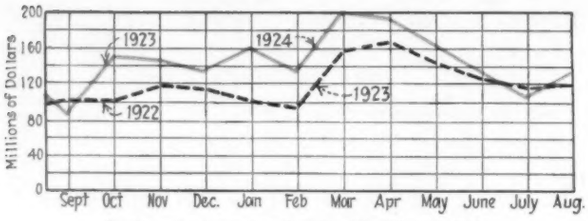
Central Station Growth

PERHAPS one of the most interesting and significant phases of central-station economics is the growth which the electric light and power industry has exhibited since the war period. During this interval industry in general has experienced two periods of activity above normal and two severe depressions, of which the second began this year and still prevails. In the present as in the former period of sub-normal activity industry in general has exhibited small signs of growth, being content to run under curtailed power until the storm shall have passed. In this respect the electric light and power industry has exhibited a very different tendency.

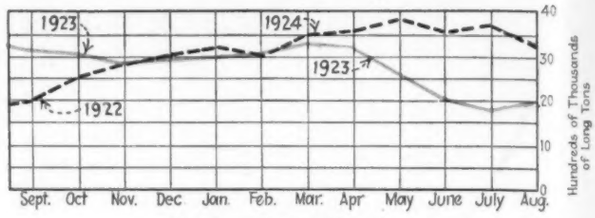
A study of the growth in central-station service in the various regions of the country makes evident the vigor of the industry and the ever-increasing part it is playing in the nation's domestic and industrial life. Despite industrial depressions, the central station marches forward with an increasing stride each year. In 1920, a year of intense industrial activity, a total of 948,300 domestic lighting customers were added to the central-station lines. In 1921, which witnessed the great sub-war business depression, 1,001,700 more American families received light and power in their homes. Last year 1,798,813 new domestic lighting customers were added to the swelling total. During the present year, despite the fact that virtually every industrial customer of the central stations has been forced to curtail activities, the total amount of energy sold and the gross revenue derived therefrom are considerably above those of last year.

Constant growth is one of the outstanding qualities of the industry. So true is this that only the severest economic crisis, leading to general chaos, could materially affect the onward progress of the central station as a whole.

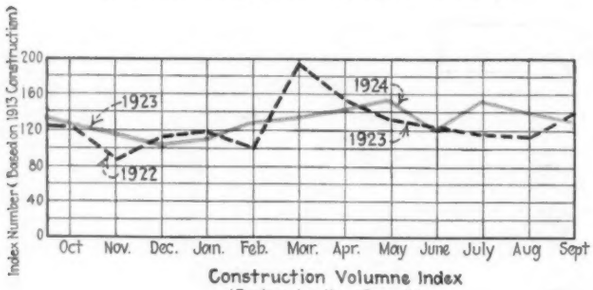
How the Primary Industries Are Trending



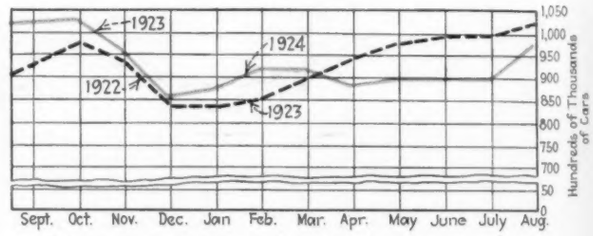
Contracts Awarded for Residential Buildings



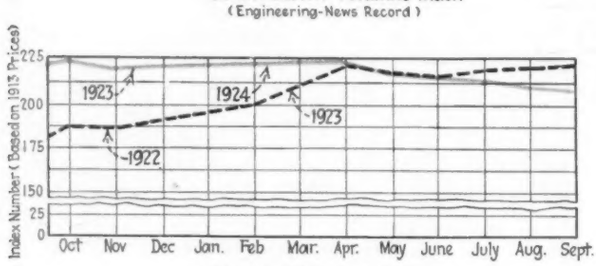
Pig-Iron Production



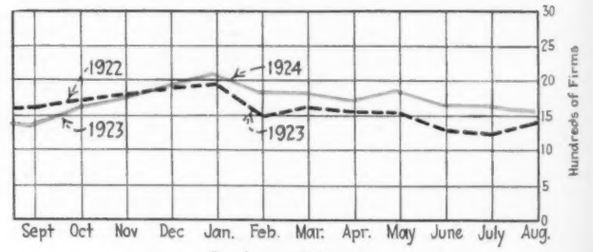
Construction Volumne Index
(Engineering-News Record)



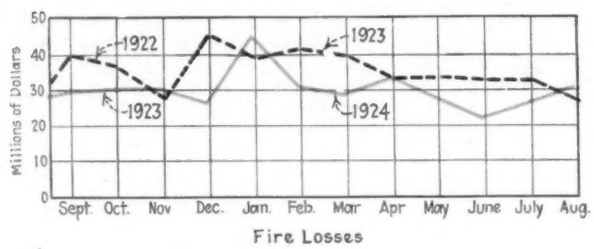
Total Average Weekly Freight-Car Loadings



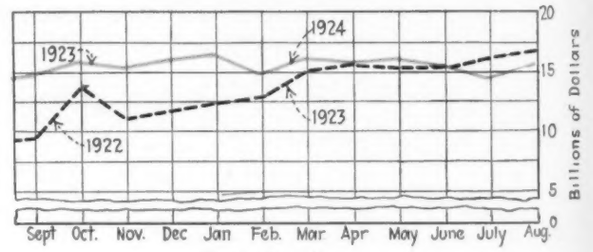
Construction Cost Index
(Engineering-News Record)



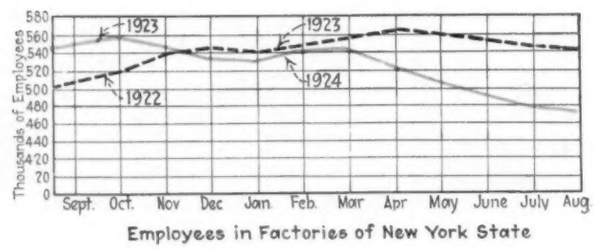
Business Failures



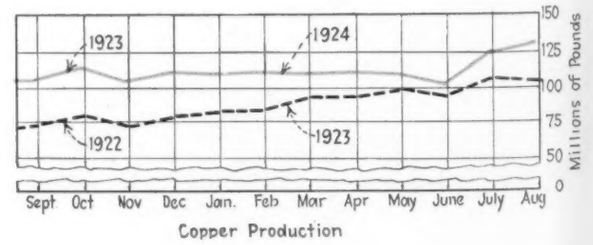
Fire Losses



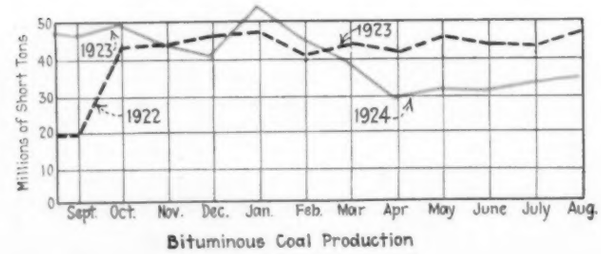
Bank Clearings
(Outside of New York City)



Employees in Factories of New York State



Copper Production



Bituminous Coal Production

Slight Improvement in Business During August

SOME slight improvement was noticeable in general business activity during August. Well-sustained building construction and recoveries in the production of iron and steel and other primary products were reported. Operations in the electrical industry as a whole were about on a par with those of July.